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NAVAL POSTGRADUATE SCHOOL

Monterey, California





THESIS REPORT

EXPERIMENTALLY DETERMINED
EFFECTS OF EDUCTOR GEOMETRY ON THE
PERFORMANCE OF EXHAUST GAS EDUCTORS FOR
GAS TURBINE POWERED SHIPS

by

John Peter Harrell, Jr. September 1977

Thesis Advisor:

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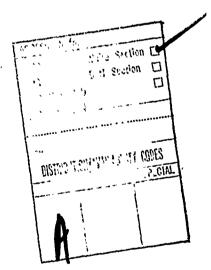
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Gas Turbine Powered Ships

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Effects of Eductor Geometry on the
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ABSTRACT

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NOMENCLATURE

English Letter Symbols

A - Area, in²

AR - Area Ratio

c - Sonic velocity, ft/sec

C - Coefficient of discharge

D - Diameter, in

f - Friction factor

Fa - Thermal expansion factor

F_{fr} - Wall skin-friction force, lbf/ft²

g_c - Proportionality factor in Newton's Second Law, g_c = 32.174 lbm-ft/lbf-sec²

h - Enthalpy, Btu/lbm

k - Ratio of specific heats

K - Flow coefficient

K_e - Kinetic energy correction factor

 K_{m} - Momentum correction factor at the mixing stack exit

 K_{D} - Momentum correction factor at the primary nozzle exit

L - Length, in

P - Pressure, in H_20 .

P - Atmospheric pressure, in Hg

 P_{tr} - Velocity head, in H_2^0

R - Gas constant for Air, 53.34 ft-lbf/lbm-°R

s - Entropy, Btu/lbm-°R

T - Absolute temperature, °R

u - Internal energy, Btu/lbm

U - Velocity, ft/sec

v - Specific volume, lbm/ft^3

W - Mass flow rate, lbm/sec

Y - Expansion factor

Dimensionless Groupings

A* - Secondary flow area to primary flow area ratio

M - Mach number

ΔP* - Pressure coefficient

Re - Reynolds number

T* - Secondary flow absolute temperature to primary flow absolute temperature ratio

W* - Secondary mass flow rate to primary mass flow rate ratio

 ρ^* - Secondary flow density to primary flow density ratio

Greek Letter Symbols

μ - Absolute viscosity, lbf-sec/ft²

ρ - Density, lbm/ft³

Subscripts

1

0 - Section within secondary air plenum

1 - Section at primary nozzle exit

2 - Section at mixing stack exit

m - Mixed flow or mixing stack

or - Orifice

P - Primary

s - Secondary

- u Uptake
- w Mixing stack inside wall

TABULATED VALUES

POR - Upstream pressure at the orifice, in H₂0

DPOR - Orifice pressure drop, in H₂0

TOR - Orifice temperature, degrees F

TUPT - Uptake temperature, degrees F

TAMB - Ambient temperature, degrees F

PU-PA - Uptake static pressure, in H₂0

PA-PS - Mixing stack entrance static pressure, in H₂0

PA-PNZ - Pressure differential across secondary flow nozzles, in H₂0

W* - Secondary mass flow rate to primary flow rate ratio

P* - Pressure Coefficient

T* - Absolute temperature ratio, secondary flow to
 primary flow

P*/T* - Dimensionless pressure coefficient

W*T*.44 - Dimensionless pumping performance

WP - Primary mass flow rate, lbm/sec

WS - Secondary mass flow rate, lbm/sec

UP - Primary flow velocity at nozzle exit, ft/sec

UM - Average velocity in mixing stack, ft/sec

UU - Primary flow velocity in uptake, ft/sec

PMS - Mixing stack static pressure, in H₂0

PMS* - Non-dimensional mixing stack static pressure

PTA - Diagonal pressure traverse at mixing stack exit, in H₂0

- PTB Horizontal pressure traverse at mixing stack exit, in H₂0
- VA Diagonal velocity traverse at mixing stack exit, ft/sec
- VB Horizontal velocity traverse at mixing
 stack exit, ft/sec

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I. INTRODUCTION

The advent of gas turbine engines as prime movers for ships has required several modifications to traditional ship designs of the past to accommodate this lightweight and powerful, yet temperamental power plant. The salt-laden sea air, if ingested unfiltered, can seriously degrade the operating life and performance of the engine. The hot engine exhaust is a potential hazard to both men and mast-mounted equipment as well as an easy target for infrared guided weaponry.

Modern gas turbine powered naval vessels such as the DD-963 class destroyers employ an exhaust gas eductor system to cool the hot gas turbine exhaust by mixing it with cool ambient air before it is discharged out the stack. A schematic diagram of a simple exhaust gas eductor defining eductor nomenclature is pictured in Figure 1.

Three major requirements are placed on eductors in this role. They must induce or pump large volumes of secondary air into the mixing stack of the eductor, they must adequately mix the hot high velocity exhaust gas and the cool low velocity secondary air to reduce the temperature peaks of the exhaust flow, and they must not impose excessive performance penalties on the gas turbine power plant.

Many investigators have examined single-nozzle eductors, but relatively few have done work with multiple-nozzle

eductors. Pucci [1] developed an improved one-dimensional analysis of a single-nozzle eductor system with a constant area mixing stack by combining a one-dimensional flow analysis with an experimentally determined momentum correction factor. He demonstrated that the performance of an eductor is dependent upon the completeness of mixing of primary and secondary flows which is a function of mixing stack length, mixing stack area to primary nozzle area ratio and secondary to primary flow-rate ratio.

ED

Ellin [2] conducted model tests of four-nozzle eductors in shipboard use, as well as tests on several proposed eductor systems. He reported results that agreed with Pucci's findings for single-nozzle eductors but found improved performance with multiple-nozzle eductors. His other major findings were that the uptake Mach number had little effect on non-dimensionalized eductor performance and that the variable having the greatest effect on performance was the mixing stack area to primary nozzle area ratio.

Moss [3] investigated four-nozzle eductor system performance as a function of geometry for a wider range of variables than did Ellin. However, he restricted his configurations tested to those that were feasible for topside exhaust gas eductors. He did not, for instance, investigate mixing stack L/D's greater than 3.0 because of the weight penalty associated with such configurations in marine applications. He reported an interdependence of nozzle standoff distance and mixing stack L/D as they affected

pumping. He also found that the same level of pumping could be attained by either the addition of a conical entrance region to the mixing stack or by manipulation of the nozzle standoff distance without the conical attachment.

It is the purpose of this study to determine the effects of eductor geometry on eductor performance as characterized by the amount of pumping achieved and the degree of mixing that occurs. By varying the eductor geometry over a wide range the general effects of geometry on performance can be deduced. Performance trends, maximums, and crossover points can then indicate areas for further concentrated investigation and add to the overall understanding of eductor performance.

The performance penalty on a gas turbine engine due to the presence of an eductor in the exhaust ducting is due to the back pressure or pressure drop caused by the eductor. The primary variable affecting pressure drop is the ratio of uptake flow area to primary nozzle area, as reported by Ellin [2]. For this study, the ratio was held constant at 3:1, that being consistent with area ratios for eductors in actual use in this application.

Five basic variables were studied: one flow variable and four geometric variables. Three primary flow rates corresponding to nominal uptake Mach numbers of 0.048, 0.068, and 0.082 were used. These flow rates are similar to those found in the uptakes of gas turbine powered ships operating at different power levels.

S

Mixing stack length to diameter ratios (L/D's) ranging from 2.0 through 11.07 were tested. The physical characteristics of the test facility determined the shortest stack that could be accommodated for each stack entrance geometry.

Nozzle standoff to diameter ratios (S/D's), as more thoroughly discussed below, were varied to determine their effects on performance.

Three mixing stack entrance region shapes were tested by attaching transition pieces to the mixing stack. The three shapes tested were elliptic, conical, and straight.

The final and most important geometrical variable tested was the primary nozzle. During phase I of the study the eductor was tested with a single primary nozzle while all of the other variables were changed. A summary of the various single-nozzle configurations tested is given in Table I. In phase II, a four-nozzle primary nozzle plate was installed, and the remaining variables were changed to determine their effects on performance. A summary of the various four-nozzle configurations tested is given in Table II.

The results of the eductor tests conducted are reported in terms of non-dimensional parameters developed by Pucci [1] and expanded upon by Ellin [2]. These parameters are derived from an analysis of a one-dimensional simple eductor. Ellin [2] has shown that the same dimensionless parameters

can be derived by using the classical Buckingham π Theorem applied to the variables of the flow.

For the present study, primary air was supplied by a turbo-compressor. The use of this relatively cool primary air had the advantages of a simpler test rig and lower cost than would have been possible with hot primary air. The classical Reynolds analogy postulates that the governing mechanisms for momentum and heat transfer are the same for fluids with Prandtl number near unity in a highly turbulent flow regime such as is found in an eductor mixing stack. For this reason, measurements of the momentum transfer in the cold flow test eductor can be theoretically correlated to the thermal energy transfer between the primary and secondary flows in an actual hot flow gas turbine exhaust eductor.

The secondary air flow in the eductor test facility was measured by placing the eductor within a large plenum.

The flow-measurement nozzles in the plenum allowed the flow of secondary air to be controlled and measured without disrupting the flow pattern within the eductor. A characteristic pumping curve was generated by restricting the secondary air flow in sequential increments by plugging the secondary flow nozzles and measuring the plenum vacuum at each step. This characteristic curve was then cast in non-dimensional form and extrapolated, as shown in Figure 2, to the maximum flow point which corresponds to the operating point for an eductor open to the environment.

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The degree of mixing in the mixing stack was determined by evaluating the amount of momentum transfer between the primary and secondary flows. The Reynolds analogy then allowed insight into the thermal mixing characteristics of the two flows. The momentum transfer is quantified by the momentum correction factor, $K_{\rm m}$, which is determined by measuring the mixing stack exit plane velocity profile. The closer the value of $K_{\rm m}$ is to unity, the greater the momentum transfer which has taken place, inferring a better mixing of the two air flows and better thermal performance.

A simpler method for evaluating thermal performance involves the value of the peak to average velocity ratio at the mixing stack exit. The evaluation of this parameter involves less approximation since integration of the velocity profile with its inherent drawbacks, is unnecessary. The average velocity can be obtained by applying the continuity equation through the eductor, once the primary and secondary air flow rates have been determined. Again, the closer the value of the peak to average velocity ratio is to unity, the better is the mixing performance of the eductor. This measure of performance is also of greater immediate utility to the designer because he can readily obtain predicted peak to average temperature performance using this data.

Both K_{m} and the peak to average velocity ratios are presented for the four-nozzle configurations tested, while only the latter is given for single-nozzle eductors.

II. THEORY AND ANALYSIS

Evaluation of the effects of eductor geometry on prototype eductor performance through experimentation with models
requires the following: assurance of similitude (geometric,
kinematic, and dynamic similarity) between model and prototype; the identification of the dimensionless groupings
controlling the flow phenomenon; and a suitable means of
data analysis and presentation. Dynamic similarity was
maintained by using Mach number similarity to establish the
model's primary flow rate. Determination of the dimensionless groupings that govern the flow was accomplished through
the analysis of a simple air eductor system. Based on this
analysis, an experimental correlation of the non-dimensional
parameters was developed and used in presenting and evaluating
experimental results.

A. MODELING TECHNIQUES

Dynamic similarity between prototype and model was maintained by duplicating the flow while accounting for differences in fluid properties arising from using relatively cool air rather than hot exhaust gas for the primary flow in the model eductor. For the flow velocities considered, the primary flow through the model eductor is turbulent (Re $\approx 10^5$). Consequently, turbulent momentum exchange is a predominant mechanism over shear interaction, and the kinetic and internal energy terms are more influential on

the flow than are viscous forces. Since Mach number can be shown to represent the square root of the ratio of kinetic energy of a flow to its internal energy, it is a more significant parameter than Reynolds number in describing the primary flow through the uptake.

Similarity of Mach number was therefore used to model the primary flow. Mach number is defined as the ratio of flow velocity to sonic velocity in the medium considered. Sonic velocity, represented by c, can be calculated using the relation

$$c = (g_c^{kRT})^{0.5}$$

if the fluid is assumed to behave as a perfect gas.

Neglecting the minor differences in the ratio of specific heats, k, and the gas constant, R, between the hot exhaust gases of the prototype and the cool air used in the model, Mach number similarity from prototype to model results in the relationship

$$\left(\frac{U_{\text{model}}}{U_{\text{prot.}}}\right) = \left(\frac{T_{\text{model}}}{T_{\text{prot.}}}\right)^{0.5}$$

This relationship was used to arrive at the model's primary flow velocity, thereby creating dynamic similarity between model and actual full scale marine eductors.

Geometric similarity was achieved by holding the ratio of mixing stack area to primary nozzle area, A_m/A_p , constant throughout the study. This ratio is similar to that found in actual shipboard exhaust gas eductors.

B. ONE-DIMENSIONAL ANALYSIS OF A SIMPLE EDUCTOR

The theoretical analysis of an eductor may be approached in two ways. One method attempts to analyze the details of the mixing process of the primary and secondary flows which takes place inside the mixing stack and thereby determines the parameters that describe the flow. This requires an interpretation of the mixing phenomenon, which, when applied to multiple-nozzle systems, becomes extremely complex. The second method, employed in this study, analyzes the overall performance of the eductor system as a unit. Since details of the mixing process are not considered in this method, an analysis of the simple single-nozzle eductor system shown in Figure 3 leads to a determination of the dimensionless groupings governing the flow. The one-dimensional analysis that follows is essentially that of Ellin [2].

The driving or primary fluid, flowing at a rate W_p and at a velocity U_p , discharges into the entrance of the constant area section of the mixing stack, inducing a secondary flow rate of W_s at velocity U_s . The primary and secondary flows are mixed and leave the mixing stack at a flow rate of W_m and a bulk average velocity of U_m .

The one-dimensional flow analysis of the simple eductor system described depends on the simultaneous solution of the equations of continuity, momentum, and energy with an appropriate equation of state and specified boundary conditions.

The following simplifying assumptions are made:

- 1. Both gas flows are treated as perfect gases with constant specific heats.
- Steady, incompressible flow throughout the eductor and plenum exists.
- 3. The flow throughout the eductor is adiabatic. The flow of secondary air from the plenum (at section 0) to the entrance of the mixing stack (at section 1) is isentropic. Irreversible adiabatic mixing occurs between the primary and secondary flows in the mixing stack (between sections 1 and 2).
- 4. The static pressure distributions across the entrance and exit planes of the mixing stack (at sections 1 and 2) are uniform.
- 5. At the mixing stack entrance (section 1), the primary flow velocity \mathbf{U}_{p} and temperature \mathbf{T}_{p} are uniform across the primary stream, and the secondary flow velocity \mathbf{U}_{s} and temperature \mathbf{T}_{s} are uniform across the secondary stream; but \mathbf{U}_{p} does not equal \mathbf{U}_{s} , and \mathbf{T}_{p} does not equal \mathbf{T}_{s} .
- 6. Incomplete mixing of the primary and secondary flows in the mixing stack is accounted for by the

use of a non-dimensional momentum correction factor, $K_{\rm m}$, which relates the actual momentum rate to the rate based on the bulk-average velocity and density and by the use of a non-dimensional kinetic energy correction factor, $K_{\rm e}$, which relates the actual kinetic energy rate to the rate based on the bulk-average velocity and density.

- Potential energy differences due to elevation are negligible.
- 8. Pressure changes P_{so} to P_{si} adn P_l to P_a are small relative to the static pressure so that the gas density is essentially dependent upon temperature (and atmospheric pressure).
- 9. Wall friction in the mixing stack is accounted for with the conventional pipe friction factor term based on the bulk-average flow velocity $\mathbf{U}_{\mathbf{m}}$ and the mixing stack wall area $\mathbf{A}_{\mathbf{u}}$.

The conservation of mass principle for steady state flow yields

$$W_{m} = W_{p} + W_{s} \tag{1}$$

where

$$W_p = \rho_p U_p A_p$$

$$W_s = \rho_s U_s A_s$$

$$W_{m} = \rho_{m} U_{m} A_{m}$$
 (1a)



Substituting for W_{m} , the bulk-average velocity becomes

$$U_{m} = \frac{W_{s} + W_{p}}{\rho_{m} A_{m}}$$
 (1b)

Now, from assumption 1

$$\rho_{m} = \frac{P_{a}}{R T_{m}} \tag{2}$$

where T_m is calculated as the bulk-average temperature for the mixed flow. Applying assumptions 4 and 6, the momentum equation for the flow in the mixing stack may be written

$$K_{p} \left[\frac{W_{p} U_{p}}{g_{c}} \right]_{1} + \left[\frac{W_{s} U_{s}}{g_{c}} \right]_{1} + P_{1}A_{1} = K_{m} \left[\frac{W_{m} U_{m}}{g_{c}} \right]_{2} + P_{2}A_{2} + F_{fr}$$
(3)

with $A_1 = A_2$. The momentum correction factor K_p is introduced to account for a possible non-uniform velocity profile across the primary nozzle exit. It is defined in a manner similar to that of K_m and by assumption 5 is equal to unity but is included here for completeness. The momentum correction factor for the mixing stack exit is defined by the relation

$$K_{\rm m} = \frac{1}{W_{\rm m} U_{\rm m}} \int_{0}^{A_{\rm m}} U_{2}^{2} \rho_{2} dA$$
 (4)

The actual variable velocity and a weighted average density at section 2 are used in the integrand. A detailed explanation of the calculation procedure for $K_{\rm m}$ is given in Appendix A. The wall skin-friction force $F_{\rm fr}$ can be related to the mean velocity by

$$F_{fr} = f A_{w} \left[\frac{U_{m}^{2} \rho_{m}}{2 g_{c}} \right]$$
 (5)

For turbulent flow, the friction factor may be calculated from the Reynolds number as

$$f = 0.046 (Re_m)^{-0.2}$$
, where $Re_m = \frac{\rho_m U_m D_m}{\mu_m}$ (6)

Applying the conservation of energy principle to the steady flow in the mixing stack with assumption 7

$$W_{p} \left[h_{p} + \frac{U_{p}^{2}}{2 g_{c}} \right]_{1} + W_{s} \left[h_{s} + \frac{U_{s}^{2}}{2 g_{c}} \right]_{1} = W_{m} \left[h_{m} + K_{e} \frac{U_{m}^{2}}{2 g_{c}} \right]_{2}$$
(7)

where K_{e} is the kinetic energy correction factor defined by the relation

$$K_{-e} = \frac{1}{W_{m} U_{m}^{2}} \int_{0}^{A_{m}} U_{2}^{3} \rho_{2} dA$$
 (8)

It may be demonstrated that for the purpose of evaluating the mixed mean flow temperature $\mathbf{T}_{\mathbf{m}}$, the kinetic energy terms may be neglected to yield

$$h_{m} = \frac{W_{p}}{W_{m}} h_{p} + \frac{W_{s}}{W_{m}} h_{s}$$
 (9)

where $T_m = \phi(h_m)$ only from assumption 1.

Similarly, the energy equation applied to the flow of secondary air between the plenum entrance and the mixing stack entrance may be reduced to

$$\frac{P_0 - P_1}{\rho_s} = \frac{U_s^2}{2 g_c} \tag{10}$$

The foregoing equations may be combined to yield the vacuum produced by the eductor in the plenum chamber

$$P_{a} - P_{o} = \frac{1}{g_{c} A_{m}} \left\{ K_{p} \frac{W_{p}^{2}}{A_{p} \rho_{p}} + \frac{W_{s}^{2}}{A_{s} \rho_{s}} \left[1 - \frac{A_{m}}{2 A_{s}} \right] - \frac{W_{m}^{2}}{A_{m} \rho_{m}} \left[K_{m} + \frac{f}{2} \frac{A_{w}}{A_{m}} \right] \right\}$$
(11)

where it is understood that A_p and ρ_p apply to the primary flow at the entrance to the mixing stack (section 1), A_s and ρ_s apply to the secondary flow at this same section, and A_m and ρ_m apply to the mixed flow at the exit of the mixing stack (section 2). P_a is atmospheric pressure and is equal to the pressure at the exit of the mixing stack P_2 . This equation also incorporates the assumption that $(\rho_s)_1 = (\rho_s)_0$ so that ρ_s may be taken as the density of the secondary flow in the plenum.

1. Non-Dimensional Solution of Simple Eductor Analysis

In order to provide the criteria of similarity of flows with geometric similarity, the non-dimensional parameters which govern the flow must be determined. One means of determining these parameters is by normalizing equation (11) which leads to the following terms:

$$\Delta P^* = \frac{\left(\frac{P_s - P_0}{\rho_s}\right)}{\left(\frac{U_p^2}{2 g_c}\right)}$$

a pressure coefficient which compares the "pumped head" $\frac{P_a - P_0}{\rho_s}$ for the secondary flow to the "driving head" $\frac{U_p^2}{2 g_a}$ of the primary flow.

$$W^* = \frac{W_s}{W_p}$$

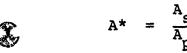
a flow rate ratio, secondary-toprimary mass flow rate.

$$T^* = \frac{T_S}{T_p}$$

an absolute temperature ratio,
secondary-to-primary.

$$\rho^* = \frac{\rho_s}{\rho_p}$$

a flow density ratio. Note that since $P_s = P_p$ and the fluids are perfect gases $\rho^* = \frac{T_p}{T_e} = \frac{1}{T^*}$.



area ratio of secondary flow area to primary flow area

$$\frac{A_p}{A_m}$$

area ratio of primary flow area to mixing stack cross sectional area

$$\frac{A_{w}}{A_{m}}$$

area ratio of wall friction area to mixing stack cross sectional area

Kp

momentum correction factor for primary flow

 $^{\rm K}{}_{\rm m}$

momentum correction factor for mixed flow

f

wall friction factor

With these non-dimensional groupings, equation (11) may be written as

$$\frac{\Delta P^*}{T^*} = 2 \frac{A_p}{A_m} \left\{ \left[K_p - \frac{A_p}{A_m} \beta \right] - W^* \left(1 + T^* \right) \frac{A_p}{A_m} \beta \right.$$

$$+ W^* T^* \left[\frac{1}{A^*} \left(1 - \frac{A_m}{2A^* A_p} \right) \frac{A_p}{A_m} \beta \right] \right\} \qquad (11a)$$

where

$$\beta = \left(K_{m} + \frac{f}{2} \frac{A_{w}}{A_{m}}\right).$$

For a given eductor geometry, equation (lla) may be expressed in the form

$$\frac{\Delta P^*}{T^*} = C_1 + C_2 W^* (T^* + 1) + C_3 W^*^2 T^*$$
 (11b)

where

$$C_{1} = 2 \frac{A_{p}}{A_{m}} \left(K_{p} - \frac{A_{p}}{A_{m}} \beta \right)$$

$$C_{2} = -2 \left(\frac{A_{p}}{A_{m}} \right)^{2} \beta \qquad (11c)$$

$$C_{3} = 2 \frac{A_{p}}{A_{m}} \left[\frac{1}{A^{*}} \left(1 - \frac{A_{m}}{2 A^{*} A_{p}} \beta \right) \beta - \frac{A_{p}}{A_{m}} \beta \right]$$

Equation (11b) may be expressed as a simple functional relationship

$$\Delta P^* = F(W^*, T^*) . \qquad (12)$$

C. EXPERIMENTAL CORRELATION

It is desirable to make a direct comparison of prototype and model performance on a one-to-one basis so that the effects of changes in geometric parameters on eductor

performance may be readily evaluated in terms of expected prototype performance. The ratio of absolute secondary to primary flow temperatures, T^* , was the only parameter which was not controlled during the experimental testing. Therefore, a means of presenting the experimental data for a given geometric configuration in a form which results in a pseudo-independence of the dimensionless groupings ΔP^* and W^* upon T^* must be developed. From equation (llb), a satisfactory correlation of ΔP^* , T^* and W^* for all temperatures and flow rates takes the form

$$\frac{\Delta P^*}{T^*} = \phi(W^*T^*) \tag{13}$$

where the exponent n is determined to be equal to 0.44 [2]. The experimental data is then correlated and analyzed using equation (13), that is $\Delta P^*/T^*$ is plotted as a function of $W^*T^{*,44}$ to yield an eductor's pumping characteristic curve. Variations in geometry will change the appearance of the pumping characteristic curve and facilitate a direct one-to-one comparison of pumping ability between model and full scale prototype eductor. For ease of discussion, $W^*T^{*,44}$ is hereafter referred to as the pumping coefficient.

III. EXPERIMENTAL APPARATUS

A. PRIMARY AIR SYSTEM

The primary air system is illustrated in Figure 4.

Primary air is provided by a Spencer turbo-compressor,

pictured in Figure 5, rated at 600 cfm at a delivery pressure

of 6 psig. Control over the flow delivered to the eductor

was provided by adjusting the gate valve 8 located between

the compressor discharge and the butterfly blast gate 6.

Air intake to the compressor was through an arrangement of 10.8 cm (4.25 inch) diameter steel pipe and 10.2 cm (4.0 inch) diameter PVC (Polyvinyl-Chloride) pipe with a 40.64 cm (16.0 inch) elliptic inlet nozzle (2) attached. The PVC pipe was connected to a valve tree (4) that provided for bypass of the inlet ducting but was not used during this study. The compressor was equipped with two flow-noise suppression devices. The first was a fiberglass lined plywood box that hooded the inlet nozzle (1) absorbed noise radiated from the nozzle. The second was a fiberglass lined plywood box (7) that was bolted to the compressor discharge just above the blast gate. The box was equipped with internal baffles which required the exhaust flow to follow a tortuous path and effectively absorbed most of the compressor exhaust flow noise without imposing a back-pressure penalty on the unit.

A short length of cloth and steel-spiral flexible hose 9 connected the compressor to the main primary ducting and allowed for an approximate 0.61 m (2 ft) difference in elevation of the two. The main primary flow ducting 10 was constructed of commercial grade ABS (Acrylonitrile-Butadiene-Styrene) 7.62 cm (3.0 inch) diameter pipe with a wall thickness of 0.81 mm (0.205 inch).

A standard ASME square-edged orifice (11) was situated 3.05 m (10 feet) downstream from the flexible hose connection. The orifice was held in place by two specially constructed plexiglass flanges which were epoxied to the pipe. Proper sealing of the orifice flanges was assured by the compression of two O-rings on either side of the orifice plate as the flanges were bolted together. orifice plate was machined from 0.239 cm (0.094 inches) thick type 304 stainless steel with an orifice diameter of 5.471 cm (2.154 inches). The inside diameter of the ABS pipe at the flanges was 7.813 cm (3.076 inches) which yields an orifice beta $(\beta = \frac{d}{D})$ of 0.700. The orifice was equipped with standard one-diameter and one-half diameter pressure taps, which, along with the other orifice specifications, are in compliance with the ASME Power Test Code [4].

The eductor uptake and the various lengths of mixing stack were cut from 7.62 cm (3.0 inch) inside-diameter smooth copper pipe with a 0.173 cm (0.068 inch) wall thickness. The 1.524 m (5.0 ft) long uptake was connected to the ABS

pipe 89 cm (35 inches) downstream from the orifice plate. A specially constructed bakelite connector equipped with 0 ring seals joined the ABS pipe to the copper pipe in a sliding, air-tight fit. The uptake pipe extended through the rear seal of the secondary air plenum and, when fitted with a nozzle, became the primary air flow element of the eductor.

B. SECONDARY AIR PLENUM

The secondary air plenum pictured in Figure 6 was constructed from 1.905 cm (3/4 inch) plywood measuring 1.22 m X 0.92 m X 0.92 m (4 ft X 3 ft X 3 ft). It served as an enclosure that surrounded and supported the eductor under test and allowed the secondary or induced air flow through the eductor to be measured by means of multiple ASME long radius nozzles penetrating the plenum. Access to the eductor was provided by a hinged top to the plenum which seated on silicone rubber gaskets on the periphery of the opening. The hinges were designed so that the application of positive pressure to the top was necessary when closing the plenum in order to engage the hold-down bolts. This feature assured an air-tight seal when the bolts were tightened.

The plenum was equipped with flow-straightening screens across the mid-section which separated the front half containing the eductor from the rear containing the secondary flow nozzles, Figure 7. The screens provided for the

damping of any gross turbulence that could affect the eductor under test.

The plenum was supported by a triangular wooden frame fitted with three leveling bolts upon which the plenum rested. The plenum and frame were light enough to permit easy movement in order to align the uptake with the primary flow ducting.

Nine ASME long radius flow nozzles constructed in compliance with the specifications in the ASME Power Test Code [4] were fitted in the rear section and in the top of the plenum as shown in Figures 6 and 7. The particular arrangement of the nozzles provided for the minimum separation distance between nozzles as specified in [4] while assuring some degree of symmetry could be maintained with regard to the open nozzles when data was taken and the nozzles sequentially plugged. Three 5.08 cm (2.0 inch) throat-diameter, three 3.81 cm (1.5 inch) throat-diameter, and three 2.54 cm (1.0 inch) throat-diameter nozzles were used which allowed for secondary air flow areas ranging between 110.21 cm² (17.082 in²), when all nozzles were open, and zero when all were plugged. The nozzles were plugged with rubber stoppers of appropriate size.

The penetration tittings for the uptake and mixing stack pictured in Figure 8 were specially constructed to provide support, sealing, and alignment. The fittings were machined from heavy bakelite and were equipped with two O-ring seals each, which provided an air-tight seal yet allowed the uptake

and mixing stack to slide in and out when changing eductor geometry.

C. INSTRUMENTATION

The performance of the eductor was calculated from pressure and temperature data taken at various points in the flow system. Compressor performance was monitored by a pressure tap and thermocouple mounted just below the blast gate in the compressor discharge. The back pressure on the compressor was critical in fixing the discharge air temperature. Throughout the study the compressor discharge pressure was maintained at six inches of mercury (2.95 psig) which kept the primary flow temperature to the eductor near 66 °C (150 °F).

The primary mass flow rate was calculated by measuring the pressure drop across the square edged orifice using the procedure detailed in the ASME Power Test Code [4]. A pressure drop of 10 inches of water (0.36 psig) across the orifice corresponded to an uptake Mach number of 0.068.

The primary flow velocity through the eductor nozzle was calculated using the uptake pressure measured just upstream of the nozzle plate. This pressure was in the 6 to 12 inches of water (0.22 to 0.43 psig) range at uptake Mach number of 0.068. Changes in eductor geometry and secondary air plenum pressure affected both orifice pressure drop and uptake pressure. This effect was compensated for as detailed in the description of experimental procedure below.

The secondary air mass flow rate was computed by using the pressure drop across the secondary air nozzles. The secondary air plenum was equipped with pressure taps mounted on four sides, both in the rear section containing the flow nozzles and in the front section containing the eductor under test. No measurable pressure drop was detected across the screens dividing the plenum so the pressure tap nearest the eductor was used in data runs.

The mixing stack pressure distribution was obtained by measuring the pressure at intervals along the mixing stack. A unique system of moveable pressure taps was devised to facilitate rapid changes in eductor geometry. The 2.36 mm (0.093 inch) pressure tap holes in the mixing stack tubes were each covered by a plexiglass saddle which contained the pressure tap fitting (see Figure 9). The saddles were installed with a thin layer of vacuum grease on their bearing surfaces to seal them to the mixing stack when fastened with a hose clamp. Installation was aided by a pin which assured proper alignment between the pressure saddles and the hole in the mixing stack. This arrangement facilitated mixing stack alignment and geometry changes by keeping the stacks free from external protuberances.

Two copper-constantan thermocouples were used to measure the compressor discharge and the primary air temperatures. The compressor thermocouple was mounted as described above. The primary air thermocouple was mounted 45.7 cm (18 inches) downstream from the orifice plate and was inserted through

the duct wall through a fitting epoxied to the duct. Both thermocouples were encased in stainless steel sheaths. The thermocouples were connected to a multi-channel Newport Digital Pyrometer which indicated the temperature in degrees Fahrenheit. The secondary air temperature was measured with a standard mercury in glass thermometer calibrated in degrees Fahrenheit.

Barometric pressure readings were taken from a standard mercury column barometer. The readings obtained were corrected for temperature and latitude (gravity correction) to yield true atmospheric pressure.

Mixing stack exit velocity distributions were obtained by measuring the diametric dynamic pressure distribution across the mixing stack using a screw driven pitot tube pictured in Figure 10. The pitot tube was held rigidly in an adjustable traversing mechanism which was aligned to drive the tube across a diameter before data was taken. The traversing mechanism allowed the measurement of radial position to within ± 0.02 inches. The pitot tube was connected to a 12 inch inclined manometer which read directly in inches of water.

A variety of manometers were used to measure the various pressures throughout the system. Available were five, four, three, two, and one-inch inclined manometers and a 10 inch vertical manometer, all filled with red oil of specific gravity 0.834 and reading directly in inches of water (see

Figure 11). A multi-tubed, 50-inch vertical manometer bank filled with water and mercury was also used.

D. CONFIGURATIONS

3

The eductor geometries studied were classified into single and four-nozzle groups. The single-nozzle geometry is illustrated in Figures 12 and 13. The four-nozzle geometry is illustrated in Figures 12 and 13.

For each nozzle group, the parametric effects on performance of mixing stack entrance shape, mixing stack length to diameter ratio (L/D), and nozzle standoff to diameter ratio (S/D) were investigated. Additionally, during phase one of the study for single-nozzle eductors, the effect of three primary flow rates was considered. Upon completion of phase one, analysis indicated that primary mass flow rate was not a strong factor in eductor performance as shown graphically in Figures 14, 15, and 16. A similar finding by Ellin [2] for four-nozzle eductors justified restricting phase two of this study for four-nozzle eductors to a single primary flow rate. The single-nozzle configurations tested are listed in Table I and the four-nozzle configurations in Table II.

The mixing stack entrance shape was varied by attaching a transition piece to the stack. Three entrance shapes were investigated; conical, elliptic, and straight (no transition).

The conical transition, manufactured from plexiglass, is illustrated in Figures 17 and 18.

The elliptic transition, also manufactured from plexiglass, is illustrated in Figures 18 and 19, and 20. The elliptic transition is essentially an ASME long radius nozzle and conforms in general to the specifications for such a nozzle with a 7.62 cm (3.0 inch) throat.

The mixing stack length to diameter ratios tested are listed in Tables I and II. In each case the L/D was computed from the open face of the transition to the end of the mixing stack as shown in Figure 21. The mixing stack diameter of 7.62 cm (3.0 inches) was constant for all cases. The curious L/D's for configurations with the elliptic transition are due to the transition length not being a multiple of 1.5 (D/2).

For the striaght entrance configuration, the transitions were removed. The mixing stack end thus exposed was machined square and sharp with no radius or bevel.

The nozzle standoff distance is the clearance between the nozzle tip and the end of the mixing stack with no transition or the transition face plane with transitions attached. Negative S/D's occur when the nozzle is inserted into the transition as shown in Figure 22. The diameter used in computing S/D is that of the mixing stack straight section, 7.62 cm (3.0 inches), regardless of the transition. The S/D's used for the straight entrance region and the conical transition are straight forward and comprehensible. However, the S/D's used for the single nozzle in conjunction with the elliptic transition require further explanation.

(')

The S/D = -0.84 occurs when the nozzle tip is inserted 6.38 cm (2.51 inches) inside the transition. It is at this point, arrived at from geometrical considerations, that the nozzle tip comes closest to the transition throat without the area between the shoulder of the uptake and the transition inner surface (area 1) being smaller than the area between the nozzle tip and the transition inner surface (area 2). In fact, it is at this point that the two areas are exactly equal. If area 1 were to become smaller than area 2, the secondary flow induced by the eductor would be governed by area 1, negating S/D as measured from the nozzle tip as a true parameter describing the eductor geometry. Therefore, S/D = -0.84 is the effective inner limit to which the nozzle tip may be inserted into the elliptic transition.

The S/D = -0.24 is the location of the nozzle tip that yields an area between the tip and transition inner surface exactly one-half of the difference between the area at S/D = 0.0 and S/D = -0.84. In equation form

$$AREA_{S/D=-0.24} = \frac{(AREA_{S/D=0}) - (AREA_{S/D=-0.84})}{2}$$

These S/D's are better parameters for performance correlation than S/D's based on some less awkward fractions which would yield performance information that could not be easily generalized to an eductor equipped with a curved transition of different shape or size.

The choice of S/D's equal to -0.25, 0.0, 0.25, and 0.5 for the four nozzle configuration when using the elliptic transition was made because of the very difficult task of computing the effective flow area between the nozzle tips and the transition from geometrical considerations. The results presented below for this configuration thus lack generality and are applicable only to an eductor equipped with an exact replica of the elliptic transition used in this study.

IV. EXPERIMENTAL PROCEDURE

Evaluation of eductor performance requires determination of the primary and secondary flow rates and some method of quantifying the degree of mixing of the primary and secondary flows. The primary and secondary flow rates describe the pumping characteristics of the eductor. The degree of mixing was determined by measuring the mixing stack exit plane velocity profile which was then integrated as described in Appendix A to determine $K_{\rm m}$, the momentum correction factor. The velocity profile also yielded information for the alternate method of evaluating the degree of mixing which involves the ratio of maximum to average velocity.

A standard sequence for experimental data collection was developed and followed rigorously in order to assure repeatability of the data from one day to the next with different atmospheric conditions. The sequence of events for a sample data run is as follows.

- Barometric pressure recorded and corrected for temperature and latitude to yield atmospheric pressure.
- 2. Turbo-Compressor started 10 to 15 minutes prior to data collection to allow exhaust temperature to stabilize.
- With manometer switching manifold open to the atmosphere, zeroed all inclined manometers. Recorded atmospheric temperature.

- 4. With secondary air plenum open, recorded mixing stack pressure distribution at uptake Mach number of 0.068.
- 5. Recorded data for velocity profile. For the four nozzle configuration, two pitot-tube traverses were made as shown in Figure 40. The "A" traverse crossed the mixing stack exit so as to pass over the centers of two radially opposed nozzles. For the "B" traverse, the uptake was rotated so that the pitot-tube traverse crossed between the nozzles.
- 6. Recorded data ΔP_{or} , P_{or} , P_{u} , and T_{u} for the plenum open condition.
- 7. Closed the plenum, recorded ΔP_{or} , P_{or} , P_{u} , T_{u} , and P_{s} with all the secondary flow measurement nozzles open.
- 8. Closed the flow measurement nozzles in a sequential manner, recording $\Delta P_{\rm or}$, $P_{\rm or}$, $P_{\rm u}$, $T_{\rm u}$, and $P_{\rm s}$ at each step. Maintained primary flow constant by maintaining $\Delta P_{\rm or}$ constant.
- Changed flow rate or geometry and repeated steps
 4 through 8.

The data collected was then punched on computer cards and processed by the NPS IBM model 360 computer to yield the non-dimensional parameters previously described that characterized the eductor performance.

As noted above in step 5, two velocity traverses were made for the four-nozzle configurations; the assumption

being that the three-dimensional velocity profile for this configuration was repeating circumferentially every 45 degrees. The integration scheme assumed that the three-dimensional velocity profile could be approximated by passing a sine curve through the repeating pattern of maximum and minimum velocities determined from the "A" and "B" traverses. The integrated flow rates calculated by this method were in close agreement (± 1%) with the flow rates calculated by combining the secondary and primary flows as measured independently.

During the course of a data set, the primary flow rate from the turbo-compressor tended to increase as the plenum flow nozzles were plugged. The differing plenum pressures were sensed upstream at the turbo-compressor discharge, causing more or less flow to pass out the bypass controlled by the butterfly valve. The primary flow rate measured through the ASME orifice was a function of the orifice pressure drop, orifice upstream pressure, and the fluid density which in turn was a function of the fluid temperature and pressure. Of these variables, only the pressure drop or the upstream pressure could be controlled, but not both. Experimentation revealed that by maintaining the pressure drop constant by adjusting the primary flow gate valve, effective one variable control over the primary flow rate could be achieved. The flow rate was maintained constant within ±3% by this method.

V. DISCUSSION OF EXPERIMENTAL RESULTS

The evaluation of eductor performance considers two things, the amount of secondary air flow induced at a given primary air flow rate, referred to here as pumping, and the degree of mixing of primary and secondary flows within the mixing stack. When an eductor is employed to cool the exhaust gas from a gas turbine engine, a high pumping rate is desirable since this results in a low average mixing stack exit temperature. The degree of mixing which occurs within the mixing stack determines how closely the local values approach Therefore, an evaluation of the performance of an eductor in this application must consider both its pumping ability and the extent of mixing produced. The approach taken in this study is to analyze the effect of specific geometric parameters individually on both pumping and mixing. Then, from the results of these analyses, the effect of a specific geometric parameter on total eductor performance is evaluated. Results of the individual analyses are summarized in Tables III, IV, V and VI.

Values of the pumping coefficient at the open to the environment operating point which are obtained from plots of experimental data using the correlation

$$\frac{\Delta P^*}{T^*} = \phi(W^*T^{*^4})$$

provide the basis for the analysis of geometric variation effects on pumping. Tabulated values of the pumping coefficient for the single-nozzle configurations tested are included in Table III and the four-nozzle configurations are included in Table IV.

The degree of mixing was evaluated by the determination of the momentum correction factor K_m or by the ratio of maximum to average velocity at the mixing stack exit. The closer either of these two values is to unity, the better the mixing that has occurred. Momentum correction factors for the four-nozzle configurations are given in Table V. Values for V_{max}/V_{avg} for the single and four-nozzle configurations are given in Table VI.

Values for $K_{\rm m}$ were not computed and detailed velocity profiles were not taken for the single-nozzle configurations. The behavior of the velocity profiles for single-nozzle configurations have been well documented by Pucci [1] and others.

The data taken for the mixing stack pressure distribution for the eductors tested was of benefit in the analysis of the performance for a particular geometry even though it was not a primary characteristic used to evaluate performance. The pressure distribution was often helpful in resolving ambiguities in the pumping and mixing performance data. The distributions presented were non-dimensionalized in a manner similar to the pumping coefficient by normalizing with the secondary density and primary flow head as

$$PMS* = \frac{PMS}{\rho_S H_D}$$

where

$$H_{D} = \frac{U_{p}^{2}}{2 g_{c}}$$

and where PMS is the measured mixing stack gage pressure, positive if greater than atmospheric and negative if less than atmospheric. A steep initial gradient for the non-dimensionalized pressure distribution curve can be interpreted as a high potential for the mixing process. Completeness of mixing can be inferred by a curve gradient which approaches zero at the mixing stack exit. Similarly, a steep initial gradient and a large negative value for the initial segment of the curve implies a high potential for pumping.

In preparing the performance plots, $\Delta P^*/T^*$ versus W^*T^{*-44} , a slight amount of data scatter is encountered as the eductor's operating point is approached. This scatter is attributed to the difficulty in measuring the very small pressure differentials, on the order of 0.10 inches of water and less, required for calculation of these last few data points. Consequently, less importance was given these scattered points when curve fitting the characteristic curve to the experimental data points.

The uncertainties in the pumping coefficient (\pm 2.8%) and the pressure coefficient (\pm 0.5) are calculated in



Appendix B. For some of the geometric parameter variations to be discussed, changes in the pumping coefficient are within its uncertainty bounds. Caution should be exercised when using these changes for purposes other than to indicate a trend. Sample curves with uncertainty bounds indicated for pumping coefficient, velocity profile, and pressure distribution are included as Figures 23, 24, and 25 respectively. An uncertainty analysis for the momentum correction factor was not attempted because of the approximations inherent in its development. It is recognized that the uncertainty in the momentum correction factor is likely to exceed its changes; such changes are used, therefore, as indications of trends only.

In the interest of completeness, all computer printouts for all the data taken during the study are included herein. The computer printouts preserve the raw data taken and provide all final calculated results as well as some intermediate quantities which characterize the eductor's performance envelope. In addition, computer-drawn graphs of pumping performance, mixing stack pressure distribution, and velocity profile data are included for the four-nozzle configurations. Caution should be exercised when using the computer-drawn plots and graphs since the data points lack precise positioning. These plots and graphs are included as useful visualizations of performance trends only. The tabulated data, however, is accurate to at least three

significant digits and should be used for numerical work with this experimental data.

Tables of experimental data and figures illustrating eductor performance are grouped under single-nozzle and four-nozzle configurations. Within each nozzle grouping, the tables are further grouped by primary flow rate, mixing stack entrance shape, L/D, and then S/D.

Figures 14, 15, 16 and 26 pertain to the single-nozzle configurations. Figures 27 and 31 through 39 likewise pertain to the four-nozzle configurations. Computer print-outs for the single-nozzle configurations are included as Tables VII through XIII. The printouts for the four-nozzle configurations are included in Tables XIV through XXIV.

The following discussion addresses the individual parametric variations and their effects on eductor performance and, in so doing, references results of tests on both single and four-nozzle configurations.

A. UPTAKE MACH NUMBER

Data for the single-nozzle configuration shows that the pumping coefficient is essentially independent of uptake Mach number. This behavior is shown in Figures 14, 15, and 16 for different L/D's. This result is in agreement with the findings of Ellin [2] and Moss [3]. Based on these results, the primary flow rate was held constant for all geometries for the four-nozzle configurations.

B. SINGLE-NOZZLE CONFIGURATION

The data for the pumping characteristic for the singlenozzle configuration shown in Figure 26 indicates an interdependence of L/D, S/D, and mixing stack entrance shape,
hereafter referred to as the transition, as they affect
pumping. It is difficult to draw conclusions regarding
any single parameter; except that, in general, increasing
L/D tends to increase pumping until L/D becomes greater than
10.

With a straight transition, S/D is seen to have a large effect on pumping at short L/D's. At an L/D of approximately 2.8, however, the performance curves tend to merge and become less dependent on S/D. The eductor equipped with an elliptic transition shows much better performance than the straight entrance, but only after S/D becomes greater than -0.84. This behavior is due to the high percentage of the secondary flow area which is blocked at S/D = -0.84. As S/D is increased greater than -0.25, its effect on pumping is less drastic.

The curves of Figure 26 indicate that the pumping coefficient reaches a maximum value in the interval 6 < L/D < 10 and then slowly falls off as L/D is increased beyond 10. The L/D corresponding to the maximum can be determined by scrutiny of the mixing stack pressure distributions in this region. The maximum performance should occur at an L/D just short of that at which the mixing stack pressure rises above atmospheric. This is indicated by the non-dimensional mixing

stack pressure exceeding zero. The uncertainty associated with the measurements of the very small pressure differences that determine the pressure distribution in a given mixing stack make this determination from the experimental data problematical at best. However, the data indicate mixing stack pressures greater than atmospheric at an L/D of 7.57 for an S/D = 0, which means the optimum L/D is somewhat less than this. Data for mixing stack pressure distributions for the single-nozzle configurations are given in Tables VII through XIII.

Of special note is the region around L/D = 3 shown in Figure 26. In this region, the performance without a transition piece seems to be approaching the performance with such a transition piece. Also of note is that the performance at this L/D is approximately 84% of the maximum achieved at much greater L/D's. These two facts are significant when applied to eductor design for exhaust gas cooling applications due to the weight limitations. Unfortunately, no data was taken which overlaps this area so the curve behavior is approximate as indicated by the dashed lines.

The degree of mixing for the single-nozzle eductor is shown graphically in Figure 28. The values for $V_{\rm max}/V_{\rm avg}$ were calculated only at a single S/D due to the time limitations of this study. The curves show a general increase in the degree of mixing as L/D is increased. The elliptic transition gives better mixing than does the straight

entrance shape at the same L/D. This effect is most probably due to blockage of the secondary air flow path into the mixing stack at small S/D's for the single nozzle.

C. FOUR-NOZZLE CONFIGURATION

Figure 27 graphically shows the pumping performance for the various four-nozzle configurations. As with the single nozzle, a strong interdependence of L/D, S/D, and transition shape is evident. The effects of small S/D's are most pronounced for small values of L/D and affect the straight transition eductor more than those equipped with a conical or elliptic transition. The shapes of the curves are similar to those of the single-nozzle configurations although shifted upward indicating better performance. A direct comparison of the single-nozzle and four-nozzle configurations for similar S/D's is made in Figure 30.

The general effect of increasing L/D is to increase pumping performance. The mixing stack pressure distributions for the four-nozzle eductor can indicate the optimum value of L/D as was discussed above for the single nozzle. Two mixing stack pressure distributions are given for each eductor configuration in the four-nozzle group in Tables XIV through XXIV. The "A" distribution is the pipe wall static pressure distribution taken when two radially opposed nozzles are in line with the wall pressure taps. The "B" distribution is taken 45 degrees away from the "A" distribution when the wall pressure taps are on a diameter which passes between

adjacent nozzles. These distributions correspond to the "A" and "B" velocity traverse directions indicated in Figure 40. The pressure distribution data indicate slight over-expansion at an L/D of 5.57 which means that the optimal L/D for a four-nozzle configuration equipped with an elliptic transition is somewhat less than that for a single nozzle eductor with similar entrance shape and S/D.

Of special significance is the region near L/D = 3. As with the single nozzle, the curves merge in this area and show a decreasing dependence on S/D and mixing stack transition shape. The four-nozzle eductor with a straight transition and L/D = 3 has an operating point pumping performance that is 92% of the maximum performance for four-nozzle eductors with greater L/D's. A four-nozzle eductor with straight transition at an S/D = 0.5 and at L/D = 3 achieves 96% of the performance of an eductor with an elliptic transition at the same L/D. This indicates a large potential savings in the weight and manufacturing complexity for eductors used to cool gas turbine engine exhausts.

Of note also is the lack of any substantive improvement in performance between an eductor with a conical entrance transition and one with the more complex elliptic shape. The improvement in performance gained by the addition of an elliptic or conical transition to the mixing stack entrance, though real, is probably not worth the added

cost, weight, and complexity that such an addition would add to a prototype design.

The mixing performance curves for the four-nozzle configurations are shown in Figure 29 for K_m and in Figure 28 for $V_{\text{max}}/V_{\text{avg}}$. Both curves show an increased degree of mixing as L/D is increased. The better mixing for the straight transition at L/D's greater than 2.5 can best be explained by recalling that both K_m and V_{max}/V_{avg} are manifestations of momentum transfer between the high velocity primary air jet and the lower velocity induced secondary air. The driving potential for momentum exchange is the difference in velocity of the two flows. The addition of the conical or elliptic transition aids the acceleration of the secondary air into the mixing stack. As the two streams enter the constant area mixing stack, the secondary air is traveling at a higher velocity than if the transition were not present. This behavior can also be deduced from a comparison of the pumping characteristics of an eductor with straight transition and with an elliptic transition. elliptic transition produces more pumping, which means an increased secondary air flow for a given primary air flow. Continuity requires that for greater volumes of air to pass through a duct of constant size, the velocity must increase.

At L/D = 3 the indications are that a straight-entrance mixing stack delivers better mixing than an elliptic or conical transition and only slightly worse pumping.

Moss [3] found that the curves for $K_{\rm m}$ for the straight and conical transitions crossed between L/D = 2 and L/D = 3. The data from this study indicate a similar trend but insufficient data were taken in this vicinity to draw firm conclusions.

D. COMPARISON OF SINGLE-NOZZLE AND FOUR-NOZZLE CONFIGURATIONS

Figure 30 shows a graphical comparison of the pumping

performance for a single-nozzle and a four-nozzle eductor

of otherwise similar geometry. The four-nozzle performance

surpasses the single-nozzle at every L/D. This is most

probably due to the increased area for momentum transfer

for the four-nozzle configuration. If the sum of the primary

nozzle circumferences is taken as a measure of the effective

area for momentum transfer, the four-nozzle configuration

is seen to have twice as much effective area as does the

single-nozzle configuration.

VI. CONCLUSIONS

The intent of this study was to obtain data relating to a broad range of geometric variables as they affected the performance of single-nozzle and four-nozzle eductors. The interdependency of geometric variables was discussed in detail in Section V; the resulting conclusions are summarized here.

- A. The effect of uptake Mach number on the non-dimensionalized performance is small and can be discounted for Mach numbers well below the range where compressibility effects come into play.
- B. Four-nozzle eductors achieve better pumping and better mixing performance than do single-nozzle eductors of otherwise identical geometry, for L/D's less than about eight.
- C. In general, increasing L/D increases pumping and mixing until L/D becomes so great that the mixing stack pressure must rise above atmospheric in order for the flow to continue. At this point frictional losses begin to have an increased effect on the flow and the pumping performance declines.
- D. For both the four-nozzle and the single-nozzle configurations, S/D is the dominant variable affecting the pumping performance for L/D's less than 4.
- E. At short L/D's, the addition of a conical or elliptic transition increases pumping but decreases mixing. For

this reason, the advantages of the addition of such a transition to shipboard eductors would not seem to out-weigh the disadvantages of added cost, weight, and complexity.

- F. At L/D's greater than 4, the addition of a conical or elliptic transition indicates an improved performance over the straight entrance. However, eductors equipped with conical and elliptic transitions did not show substantial differences in performance.
- G. By properly choosing S/D, an eductor with a straight entrance can achieve pumping equivalent to that of an eductor with a conical or elliptic transition at L/D's near 3. The same straight entrance configuration exhibits greater mixing than does the conical or elliptic transition configuration which, when all factors are considered, indicates that the straight entrance configuration is a better choice for the design of gas turbine exhaust gas eductors with L/D's near 3.

VII. RECOMMENDATIONS

In addition to the insight this study has given into the relationship between eductor geometry and performance, it has generated an awareness of a few shortcomings. Presented here are recommendations concerning areas requiring further study and certain improvements in apparatus which would make further study easier.

- A. More data are needed for the region of L/D between 2 and 4. It is this region which seems to offer the best promise for maximizing performance without incurring large weight and complexity penalties.
- B. The method of evaluating the thermal behavior of an eductor mixing stack by examination of the momentum transfer is approximate. Hot flow model tests are needed to confirm the validity of the approximation.
- C. The three-inch uptake and mixing stack sizes, though convenient for rapid geometry changes, presented problems in achieving precise alignment. The use of larger size uptakes and mixing stacks would obviate the necessity for the time consuming and tedious alignment of the uptake with the mixing stack.
- D. The uncertainties involved in the calculation of the open-to-the-environment operating point of the eductor and in the determination of the mixing stack pressure

distribution could be substantially reduced by the use of more sophisticated pressure measurement methods than were available for this study.

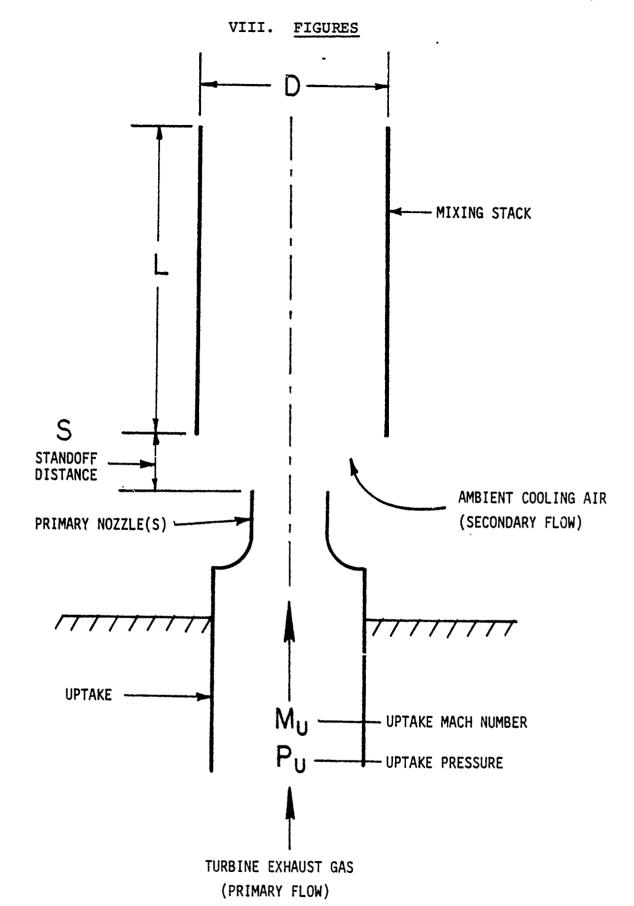


FIGURE 1. Schematic Diagram of Simple Exhaust Gas Eductor

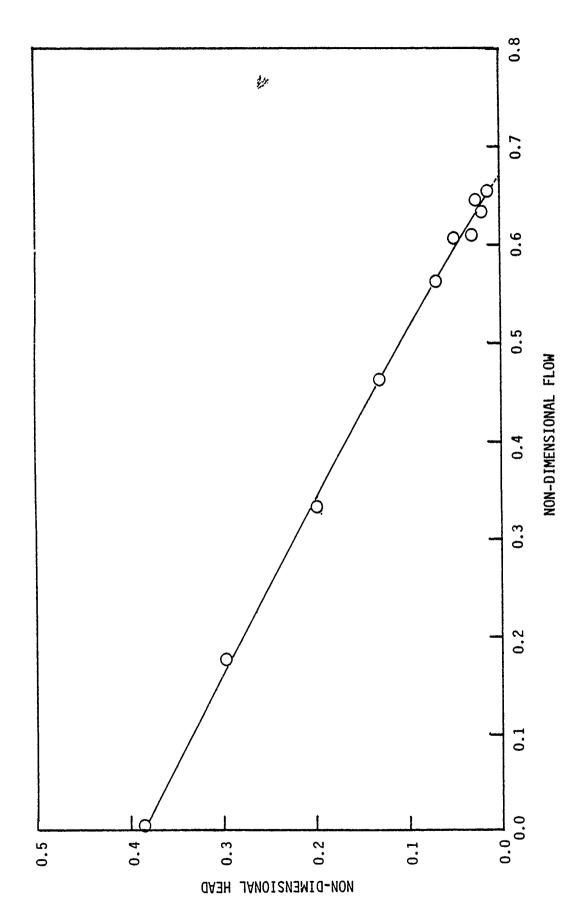


FIGURE 2. Sample Non-Dimensional Pumping Coefficient Curve.

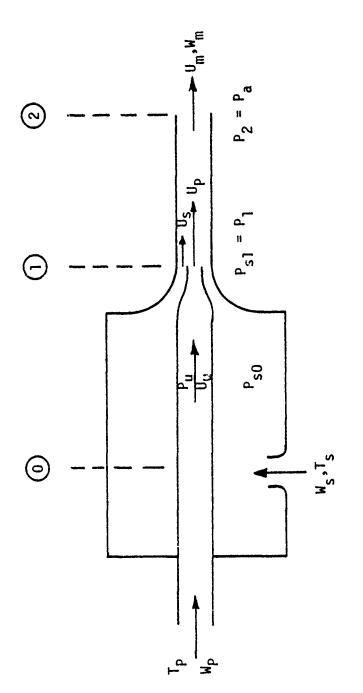


FIGURE 3. Simple Single-Nozzle Eductor System.

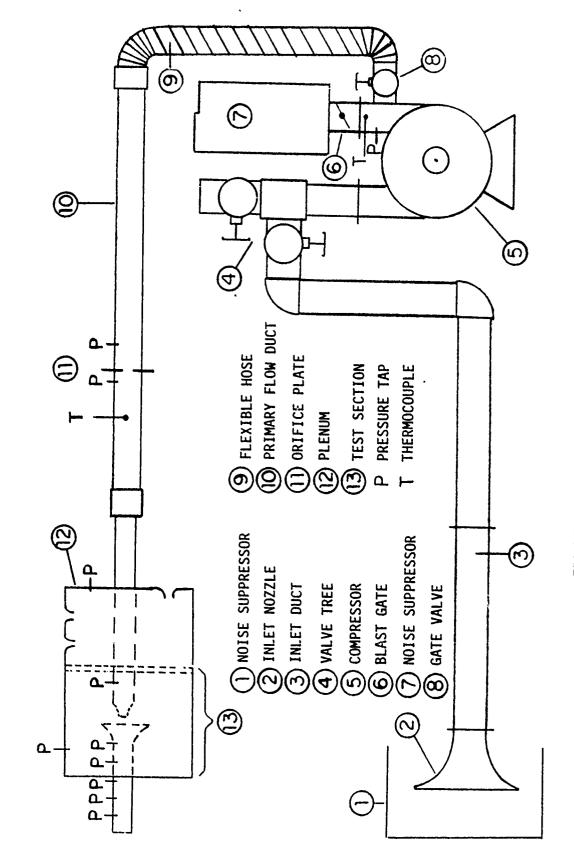


FIGURE 4. Test Rig Schematic Diagram.

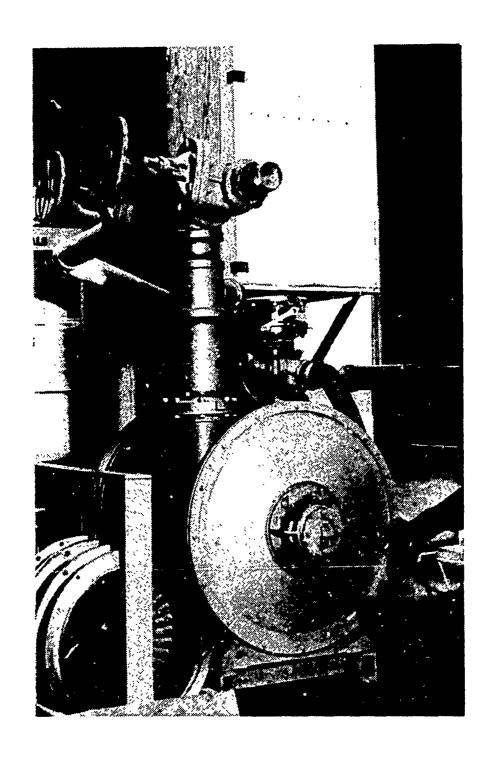


FIGURE 5. Primary Air Supply Turbo-Compressor.

FIGURE 6. Secondary Air Plenum and Flow-Measuring Nozzles.



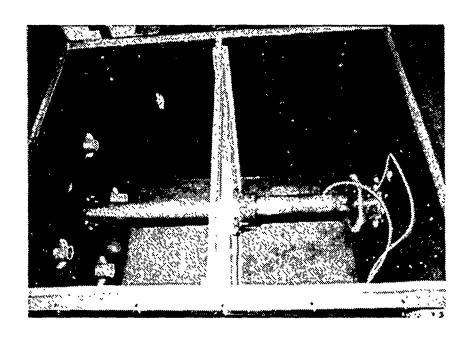


FIGURE 7. Secondary Air Plenum Interior.

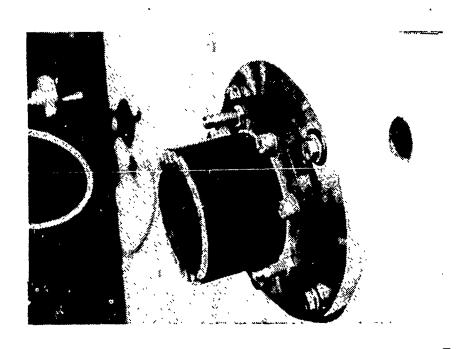


FIGURE 8. Plenum Penetration Fitting.

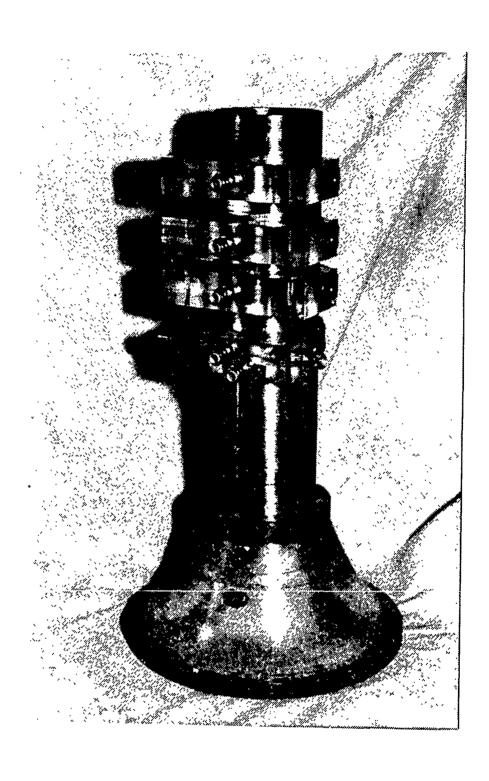


FIGURE 9. Mixing Stack with Elliptic Transition and Plexiglass Pressure Saddles.

FIGURE 10. Mixing Stack Exit and Pitot-Tube Traversing Mechanism.

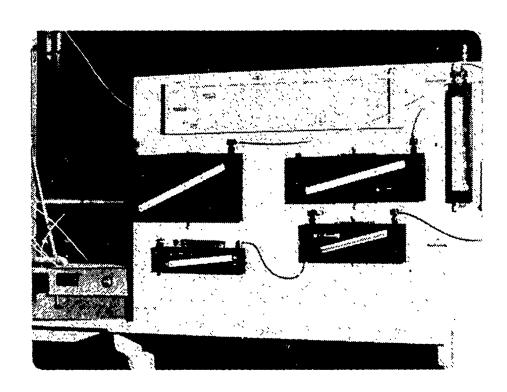


FIGURE 11. Digital Pyrometer and Main Manometer Board.

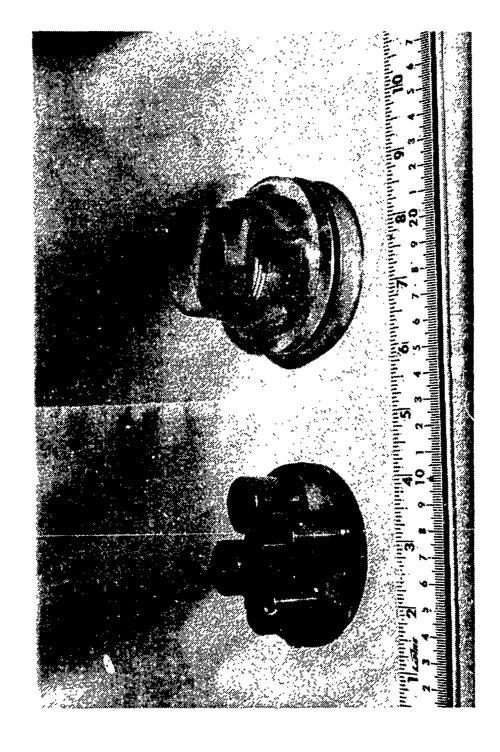


FIGURE 12. Four-Nozzle Plate and Single-Nozzle Primary Flow Nozzles.

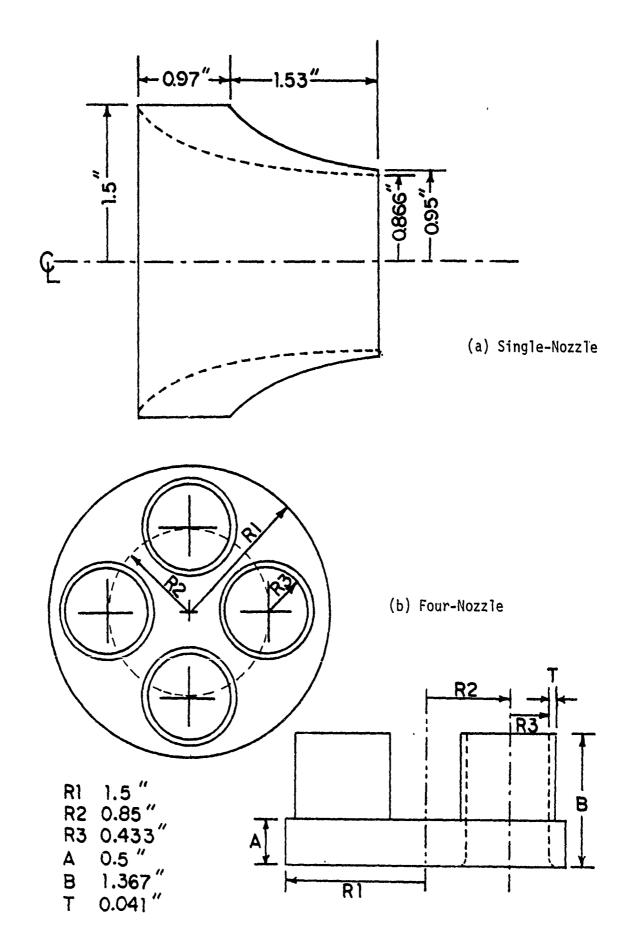
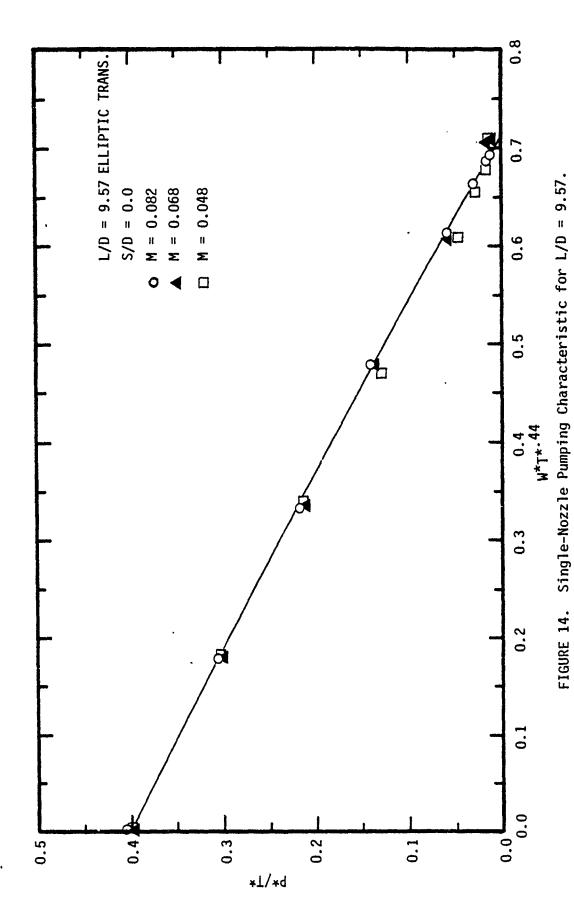
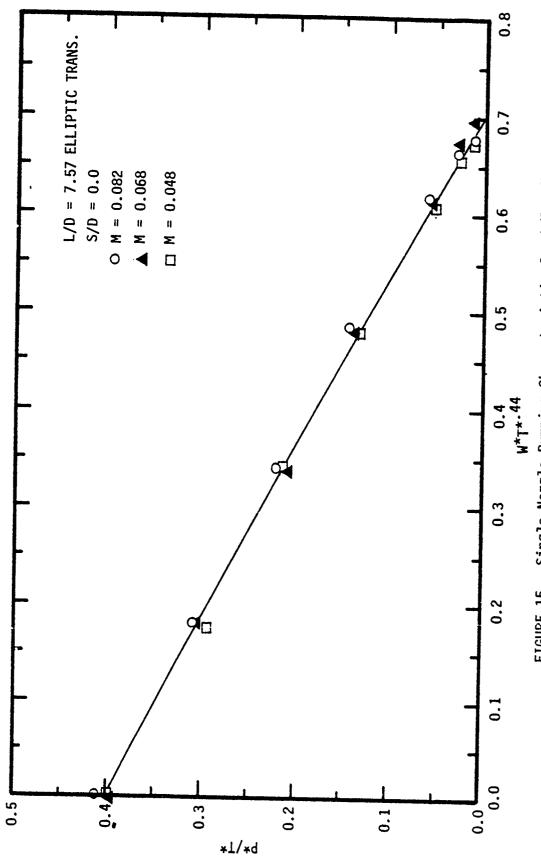


FIGURE 13. Single and Four-Nozzle Geometries.





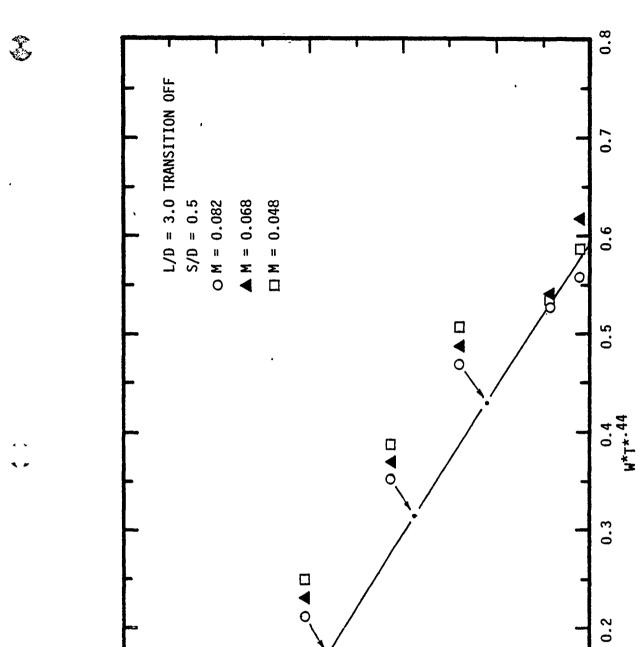


FIGURE 16. Single-Nozzle Pumping Characteristic for L/D = 3.0.

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0.1

*T/*q

0.3

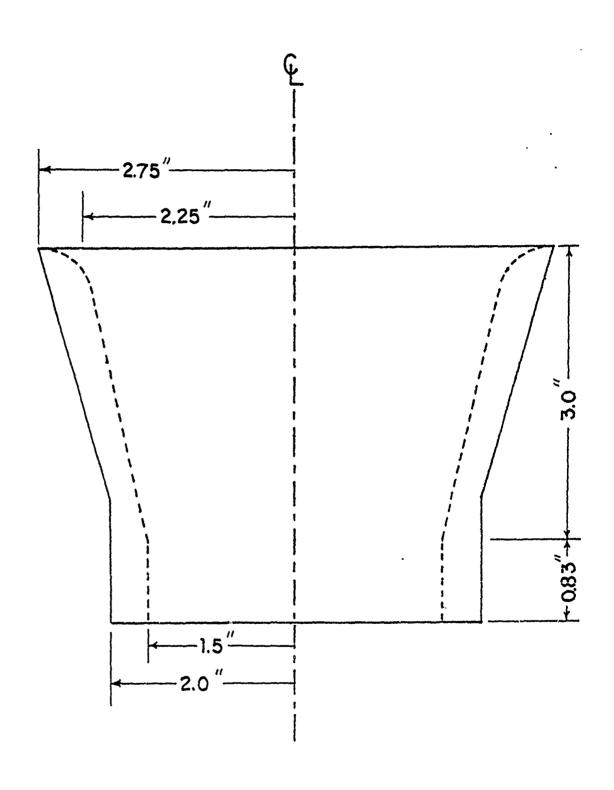


FIGURE 17. Conical Transition Geometry.

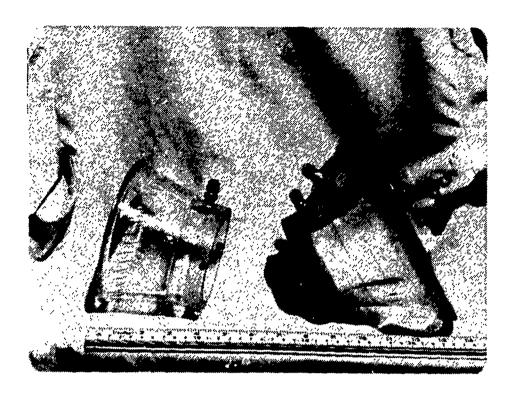




FIGURE 18. Elliptic and Con'cal Transitions.

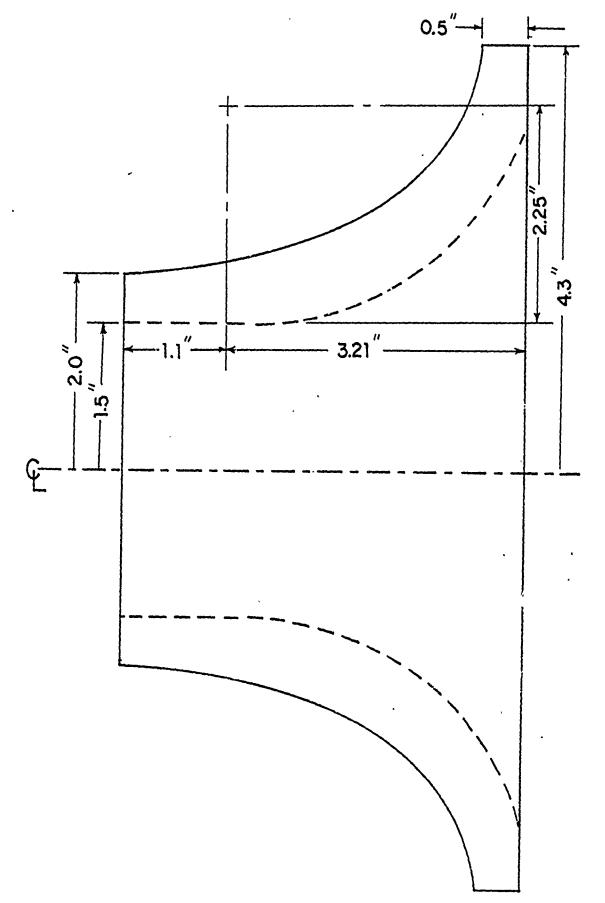


FIGURE 19. Elliptic Transition Geometry.



FIGURE 20. Four-Nozzle Eductor with Elliptic Transition.

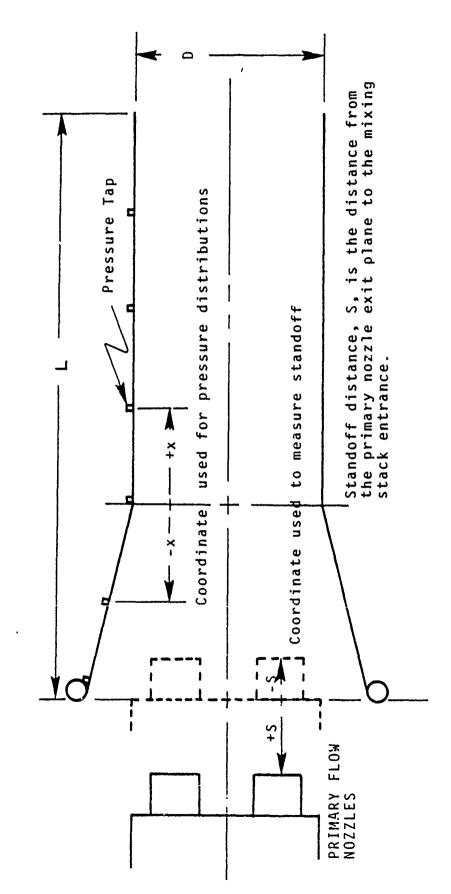


FIGURE 21. Eductor Coordinate Systems.

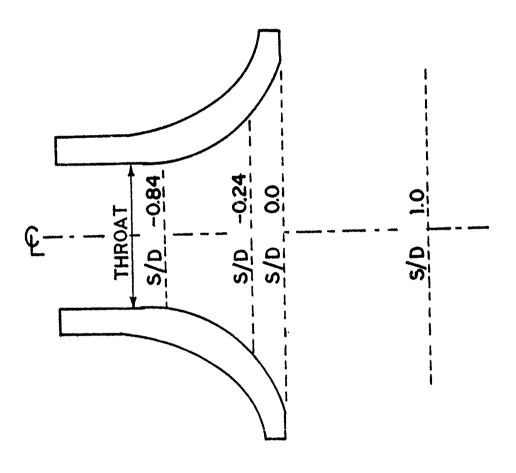
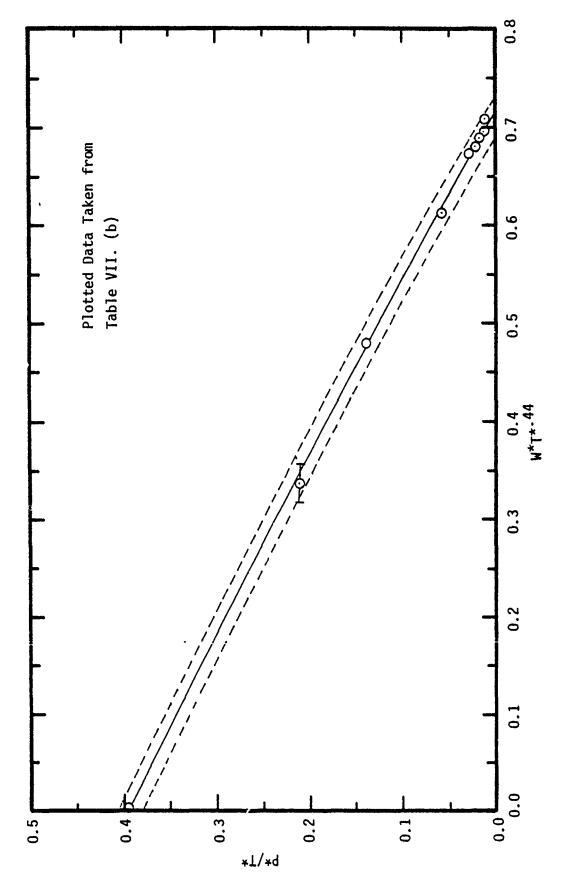


FIGURE 22. S/D Positions for Elliptic Transition.



Sample Pumping Performance Curve with Uncertainty Bounds. FIGURE 23.

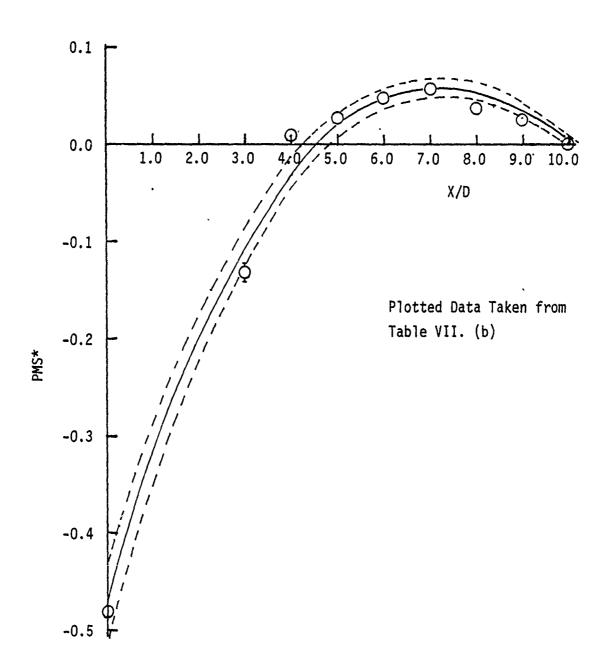
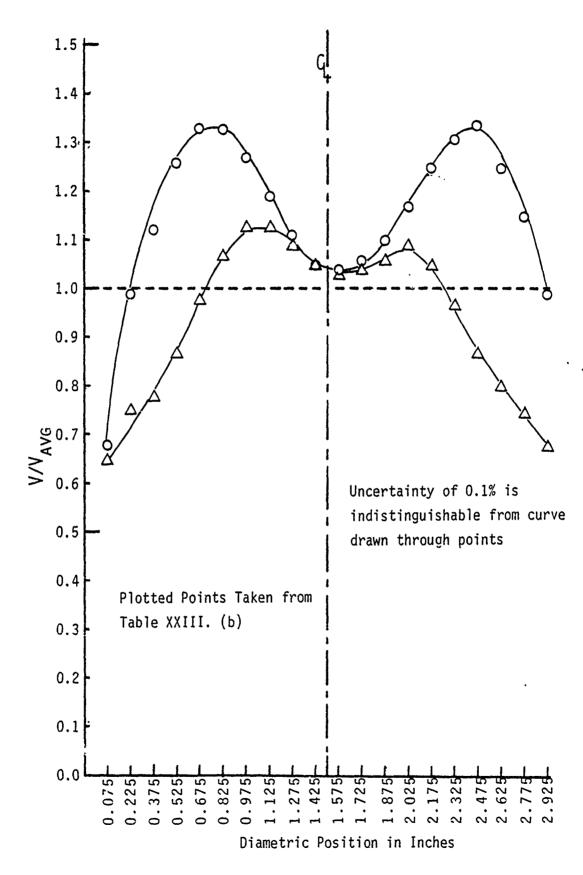
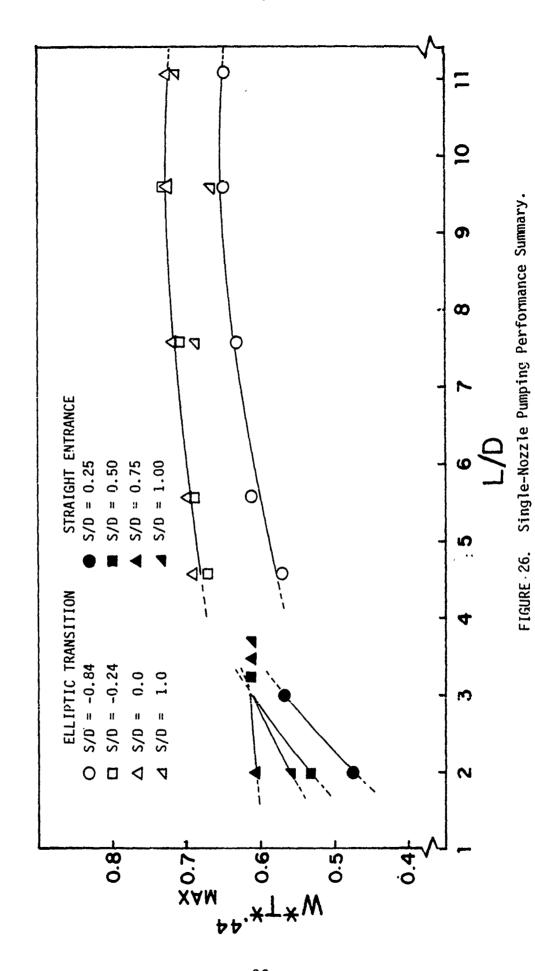


FIGURE 24. Sample Pressure Distribution Curve with Uncertainty Bounds.



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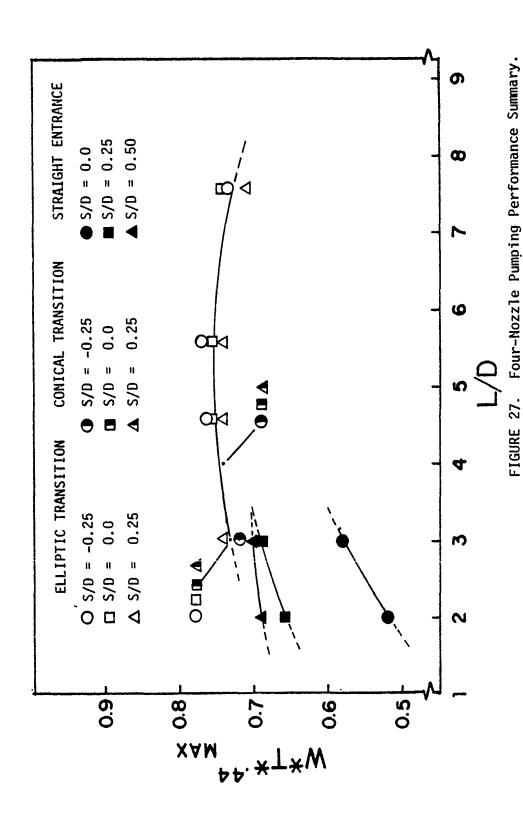
FIGURE 25. Sample Velocity Profile with Uncertainty Bounds.





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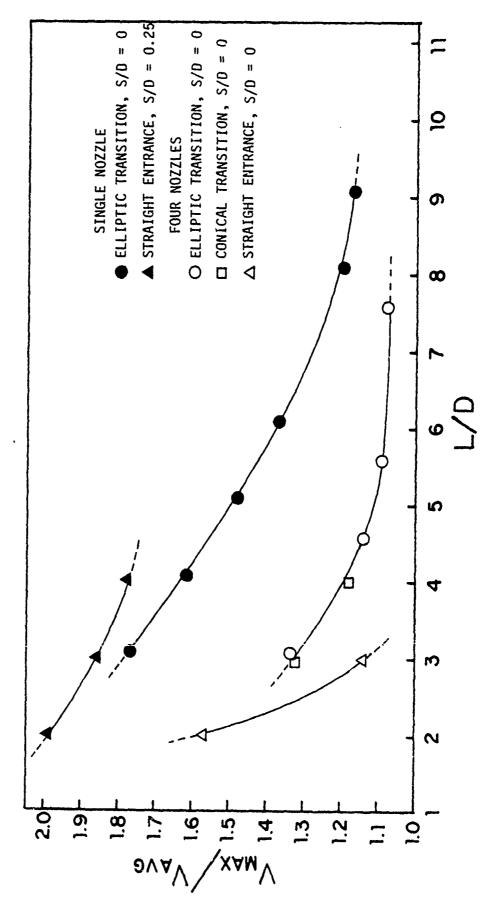
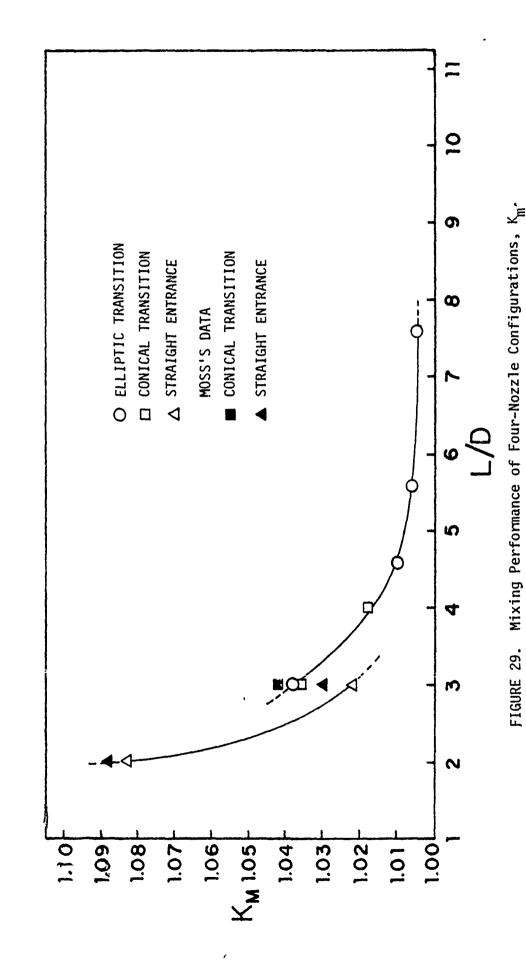
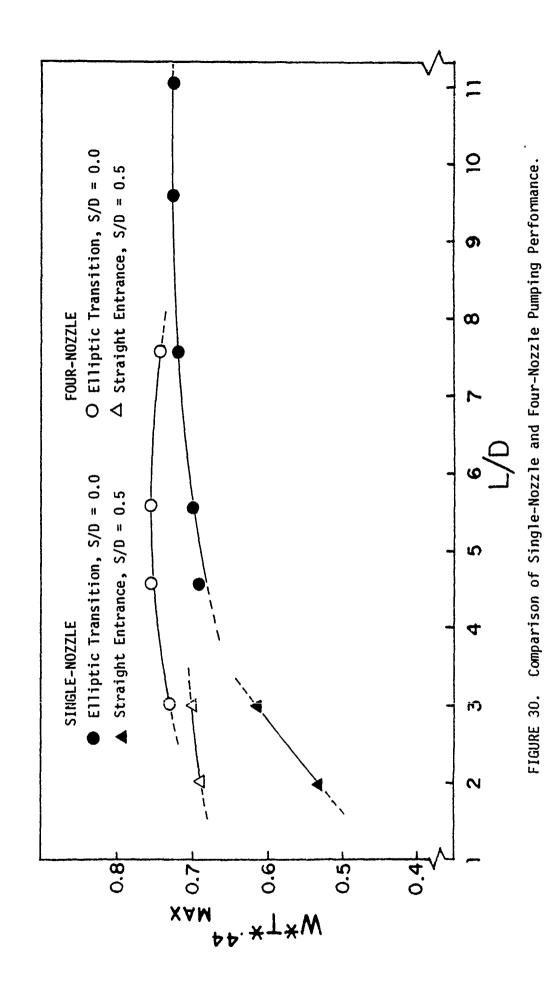


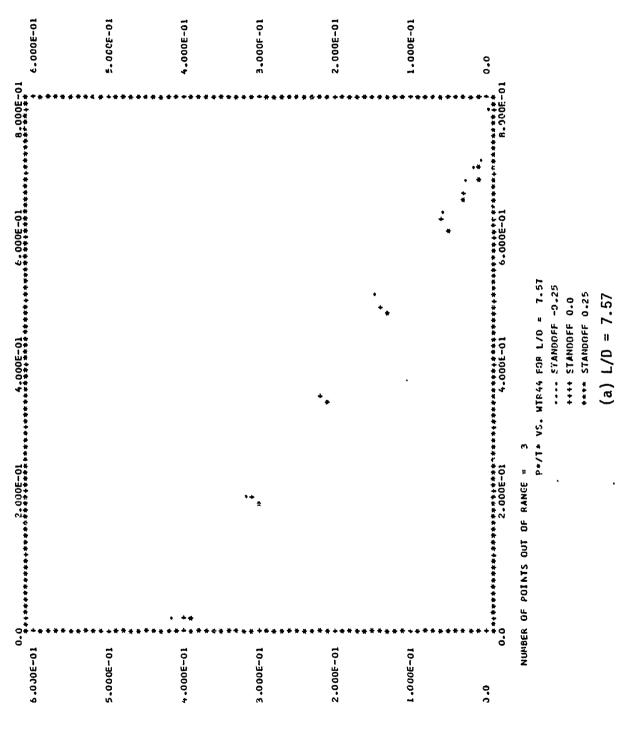
FIGURE 28. Mixing Performance of Single and Four-Nozzle Configurations, V_{max}/V_{avg}.



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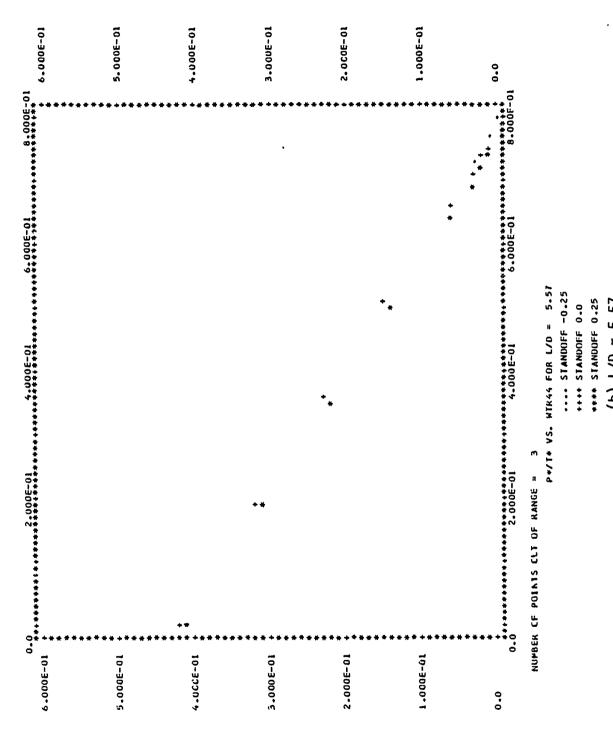
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Effects of S/D on Pumping Performance for Four Nozzles, Elliptic Transition, $M_u=0.068$. FIGURE 31.



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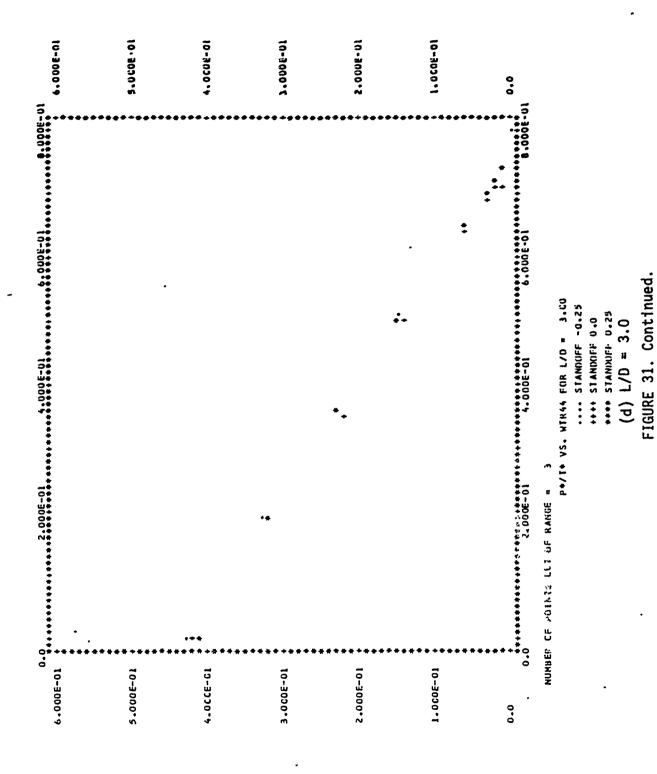
(b) L/D = 5.57FIGURE 31. Continued.

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(c) L/D = 4.57

FIGURE 31. Continued.



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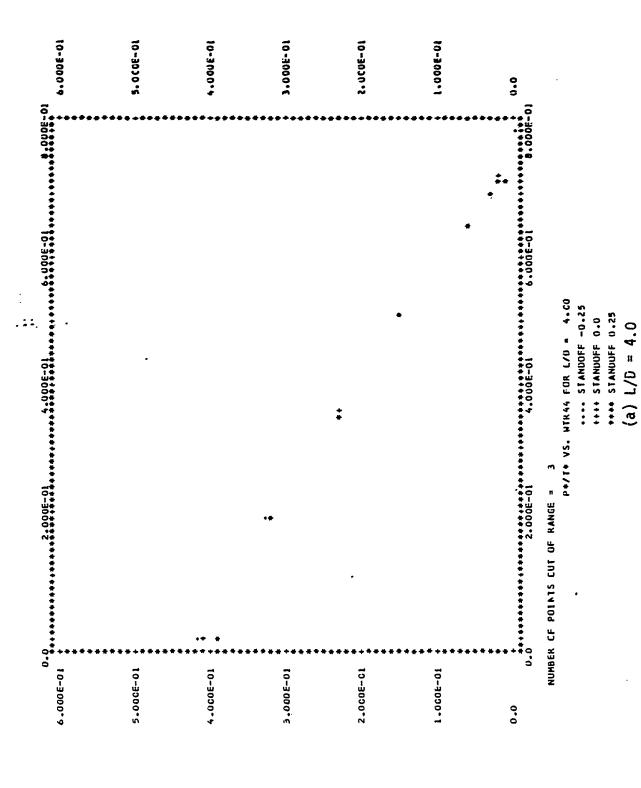
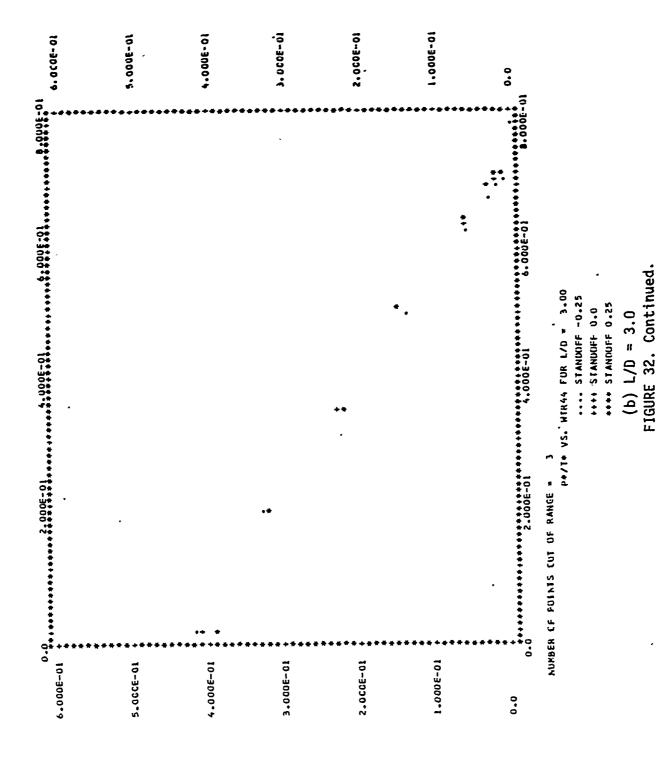


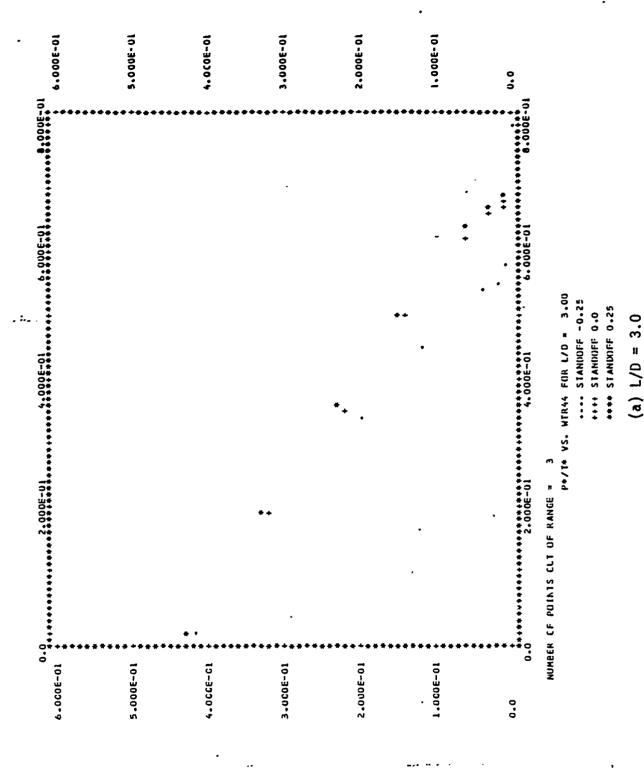
FIGURE 32. Effects of S/D on Pumping Performance for Four Nozzles, Conical Transition, Mg = 0.068.

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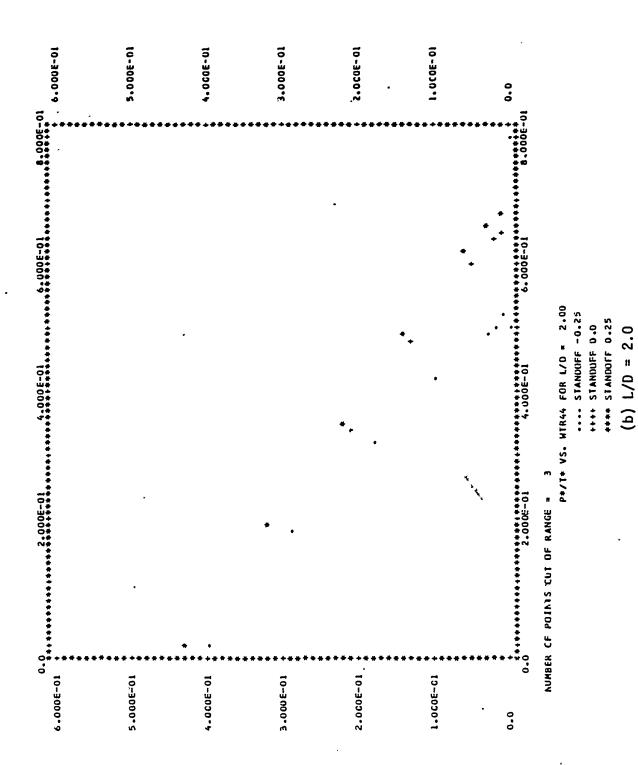
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Effects of S/D on Pumping Performance for Four Nozzles, Straight Entrance, M_u = 0.068. FIGURE 33.

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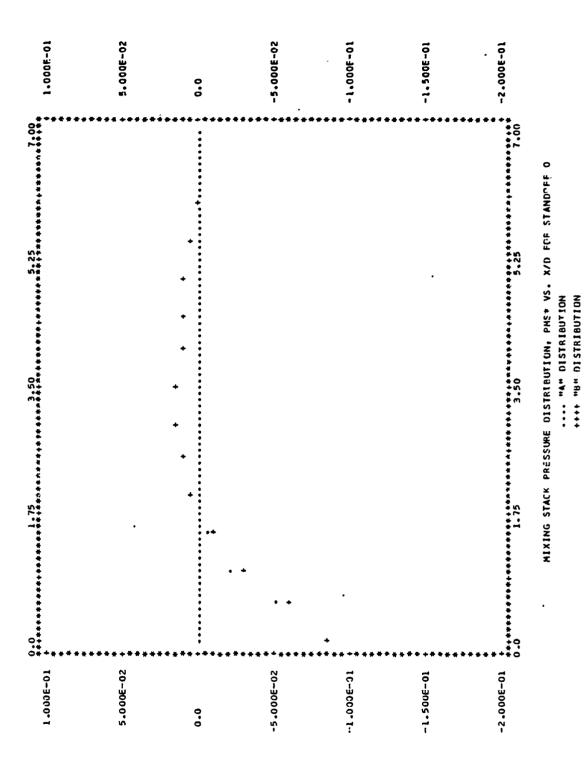
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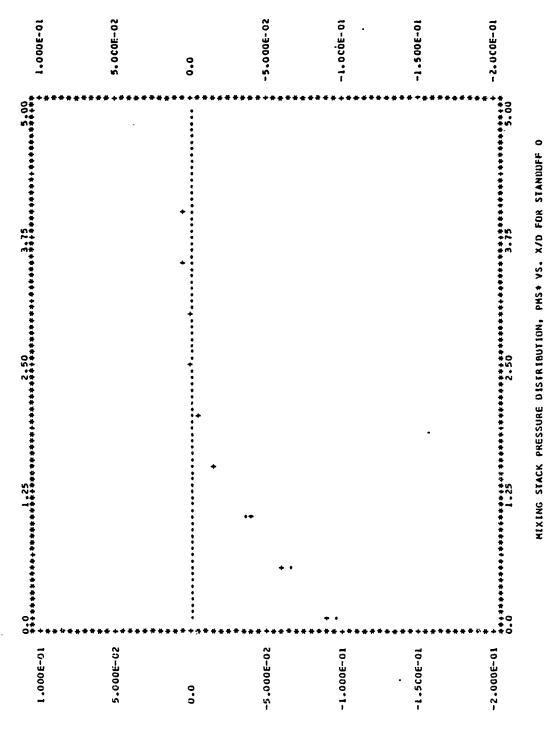
FIGURE 33. Continued.

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Mixing Stack Pressure Distributions for Four Nozzles, Elliptic Transition, Mg = 0.068. FIGURE 34.

(a) L/D = 7.57

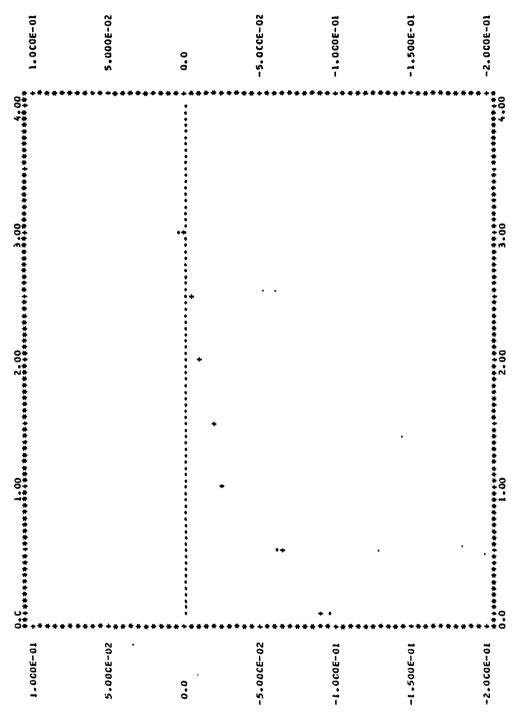


ad named and a deption and management and the demand the grant party of the committee of the control of

.... "A" DISTRIBUTION

(b) L/D = 5.57

FIGURE 34. Continued.



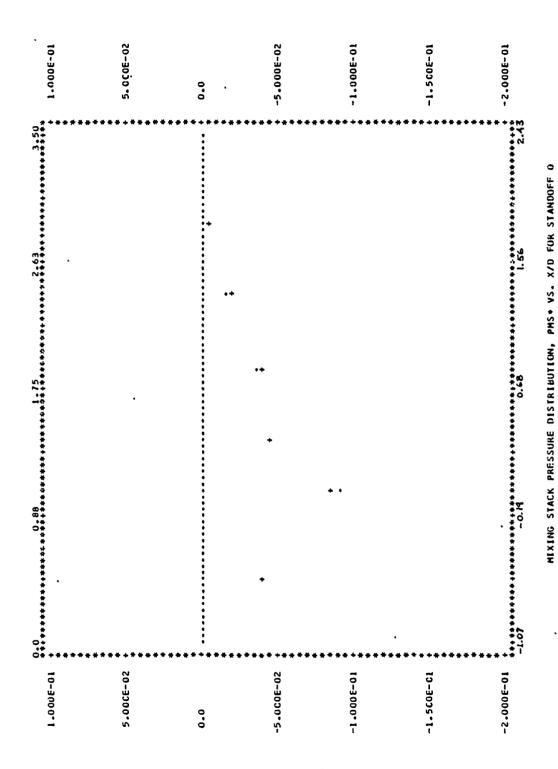
HIXING STACK PRESSURE DISTRIBUTION, PMS* VS. X/D FOR STANDOFF O

... "A" DISTRIBUTION

++++ "B" DISTRIBUTION

(C) L/D = 4.57

FIGURE 34. Continued.



.... "A" DISTRIBUTION (d) L/D = 3.0

FIGURE 34. Continued.



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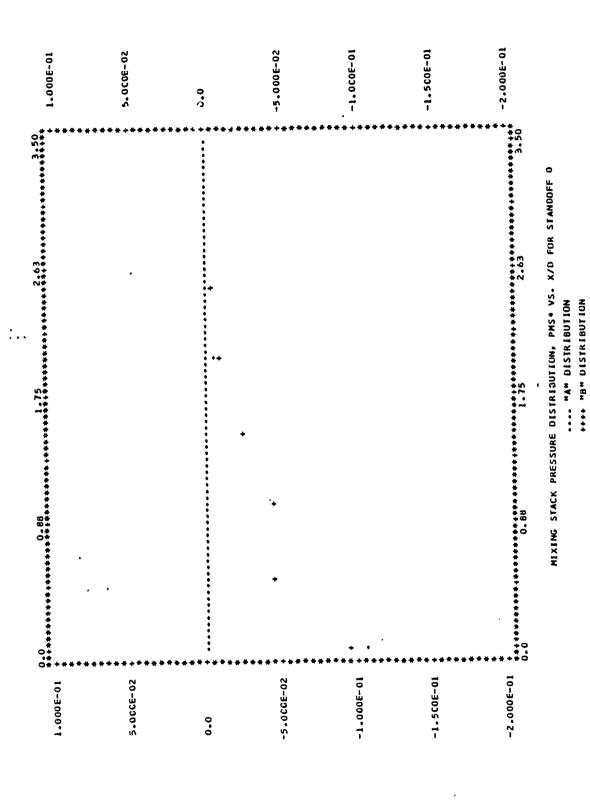
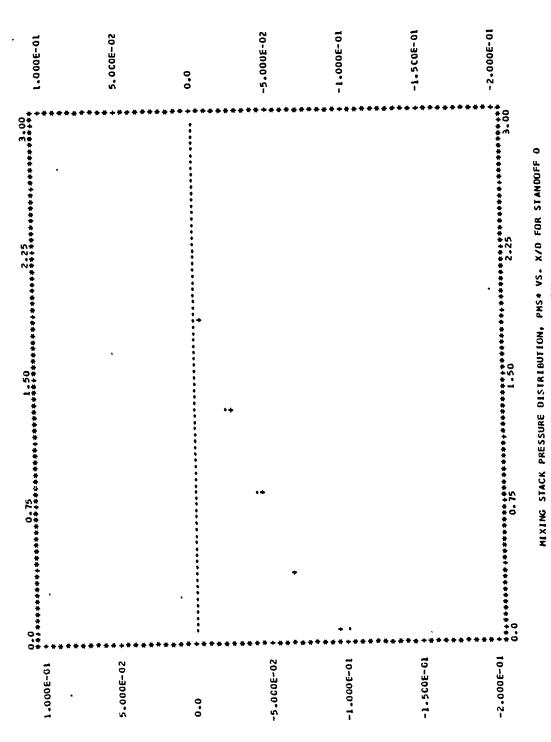


FIGURE 35. Mixing Stack Pressure Distributions for Four Nozzles, Conical Transition, $M_{u}=0.068$.

(a) L/D = 4.0

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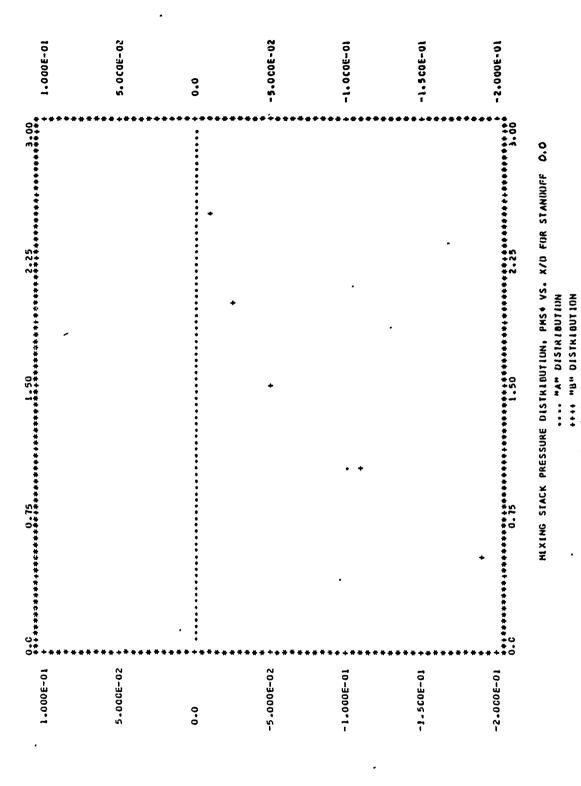




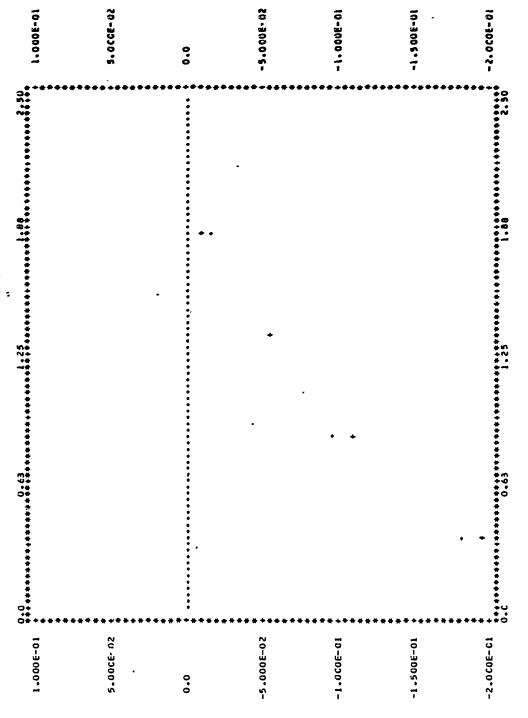
.... "A" DISTRIBUTION ++++ "B" DISTRIBUTION

(b) L/D = 3.0

FIGURE 35. Continued.



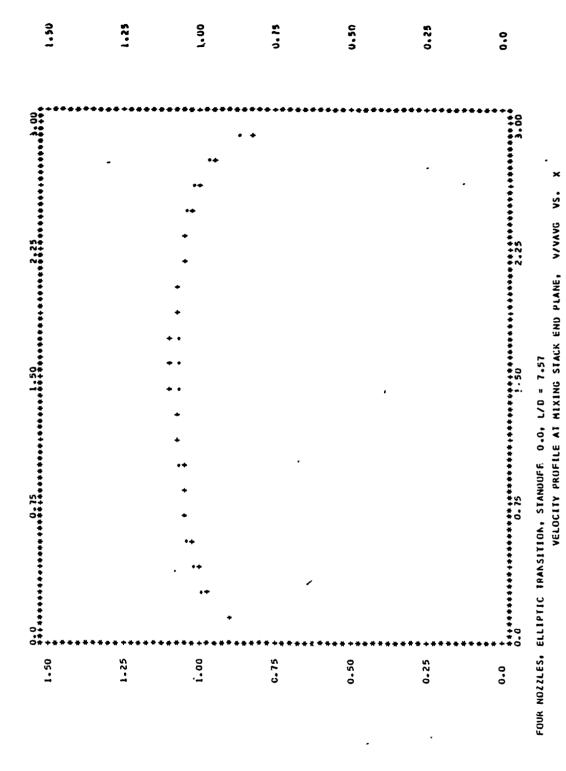
Mixing Stack Pressure Distributions for Four Nozzles, Straight Entrance, M_u = 0.068. (a) L/D = 3.0FIGURE 36.



0 MIXING STACK PRESSURE DISTRIBUTION, PMS+ VS. X/D FUR STANDUFF "A" DISTRIBUTION
, ++++ "B" DISTRIBUTION

(b) L/D = 2.0

FIGURE 36. Continued.



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Mixing Stack Exit Velocity Profiles for Four Nozzles, Elliptic Transition, M_u = 0.068. FIGURE 37.

.... A IMAVERSE

++++ B IMAVERSE

(a) L/D = 7.57

0.0 1.50 1.25 1.00 0.75 0.50 0.25 0.0

.50

1.25

00.1

0.75

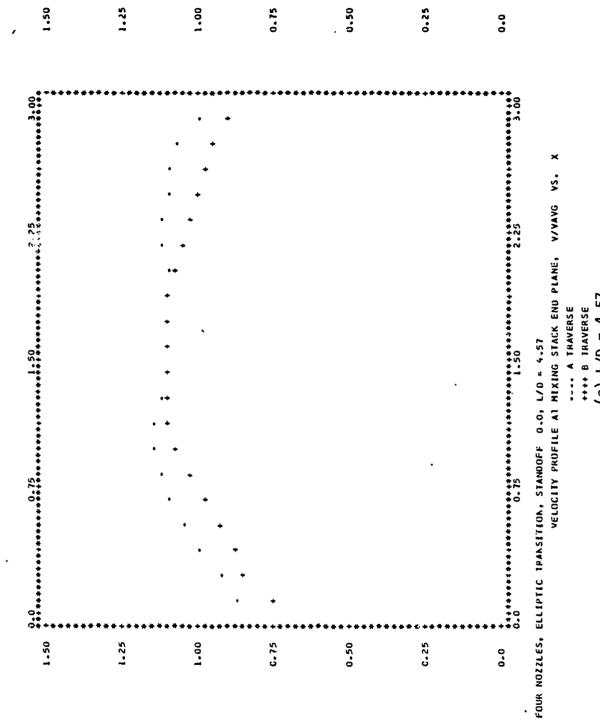
0.50

0.25

110

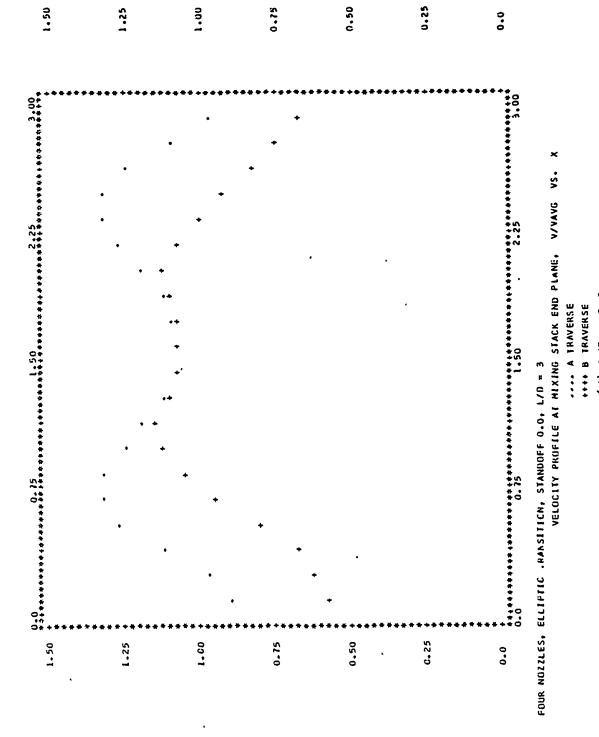
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FIGURE 37. Continued.



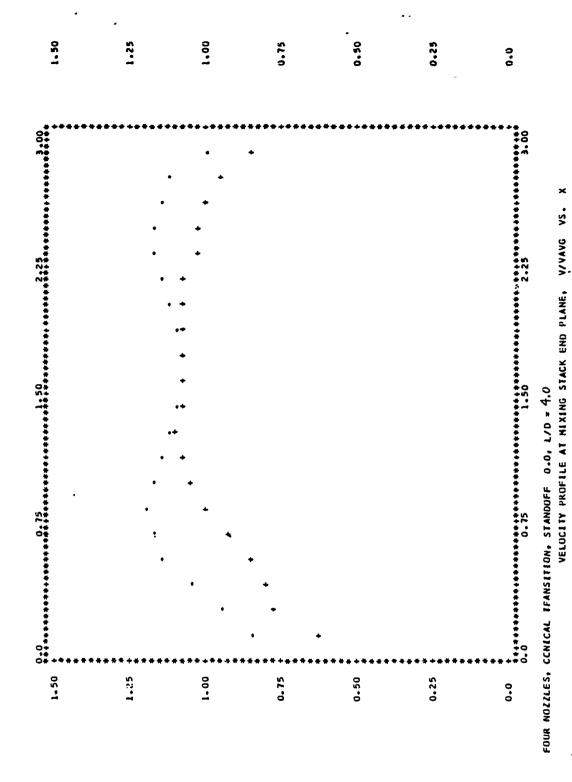
(c) L/D = 4.57

FIGURE 37. Continued.



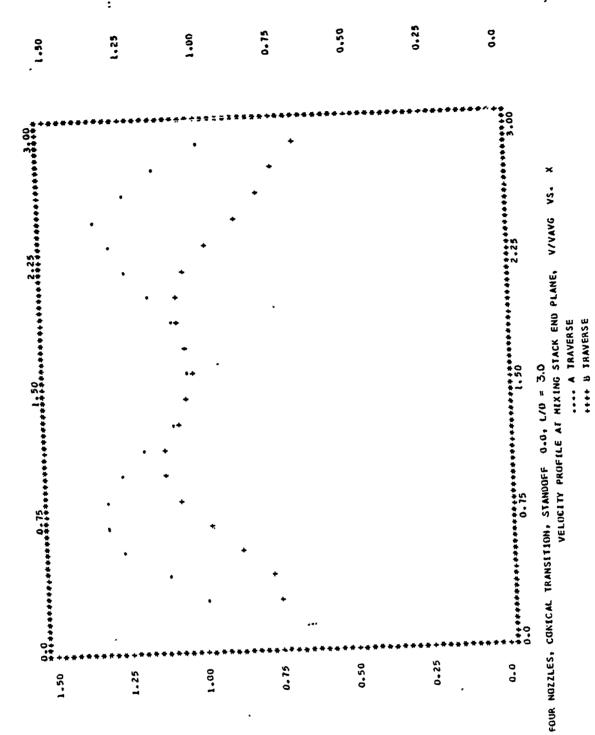
112

FIGURE 37. Continued. (d) L/D = 3.0



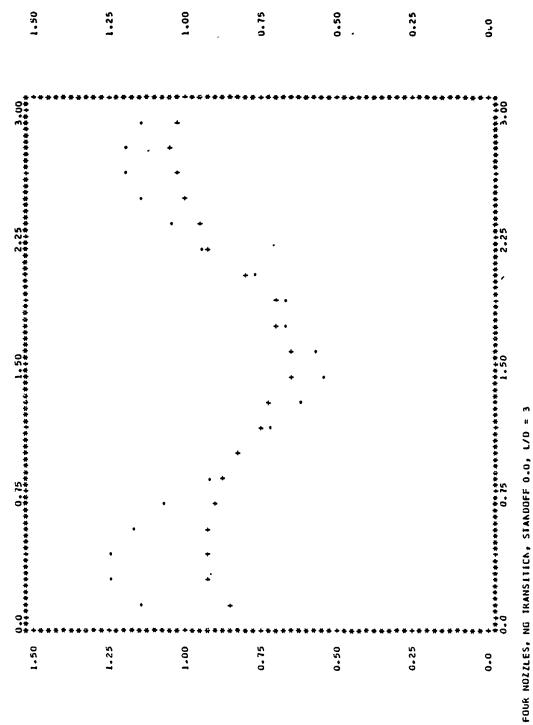
Mixing Stack Exit Velocity Profiles for Four Nozzles, Conical Transition, M_u = 0.068. (a) L/D = 4.0FIGURE 38.

... A TRAVERSE



114

FIGURE 38. Continued. (b) L/D = 3.0

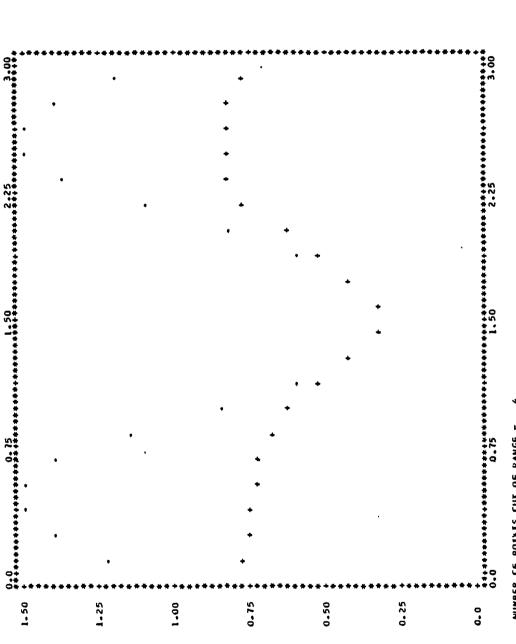


VELOCITY PROFILE AT MIXING STACK END PLANE, V/VAVG VS. (a) L/D = 3.0.... A TRAVERSE

Mixing Stack Exit Velocity Profiles for Four Nozzles, Straight Entrance, M_{u} = 0.068.

FIGURE 39.

the light formers and the property over the second former of the second former of the second former of the second formers of the sec



1.50

1.25

1.00

0.75

0.50

0.25

0.0

FOUR NOZZLES, NO TRANSITION, STANDOFF 0.0, L/O = 2 VELOCITY PROFILE AT MIXING STACK END PLANE, V/VAVG VS.

... A TRAVERSE ... B TRAVERSE (b) L/D = 2.0

FIGURE 39. Continued.

SINGLE-NOZZLE CONFIGURATIONS

EACH CONFIGURATION TESTED AT 3 FLOW RATES; M = 0.048, M = 0.068, M = 0.082

S/D	L/D	11.07	9.57	7.57	5.57	4.57	3.0	2.0
	-0.84	х	Х	Х	Х	Х		
TIC 10N	-0.24		Х	X	Х	Х		
ELLIPTIC TRANSITION	0.0	х	х	Х	Х	Х		
	1.00		Х	X				
	0.25						Х	х.
N OFF	0.50						Х	Х
TRANSITION OFF	0.70						х	Х
TRA	1.00						χ	Х

Table I. Single-Nozzle Configurations Tested.

FOUR-NOZZLE CONFIGURATIONS

EACH CONFIGURATION TESTED AT NOMINAL FLOW RATE M = 0.068

S/D	L/D	7.57	5.57	4.57	4.0	3.0	2.0
	-0.25	Х	х	Х		Х	:
PTIC	0.0	Х	Х	Х		х	
ELLIPTIC TRANSITION	0.25	х	х	Х		Х	
	0.50	Х					
AL ON	-0.25 ·				X	Х	
CONICAL	0.0				Х	Х	
TR	0.25				X	Х	
0FF	0.0					Х	Х
TRANSITION	0.25					х	х
TRAN	0.50					Х	Х

Table II. Four-Nozzle Configurations Tested.

L/D S/D	11.07	9.57	7.57	5.57	4.57	3.0	2.0
ELLIPTIC TRANSITION							
-0.84	0.648	0.648	0.631	0.611	0.572		
-0.24		0.733	0.707	0.692	0.672		
0.0	0.720	0.728	0.720	0.698	0.691		
1.0	0.720	0.663	0.687				
STRAIGHT ENTRANCE							
0.25						0.569	0.472
0.50						0.613	0.534
0.75						0.612	0.606
1.0						0.615	0.560

ALL DATA FOR UPTAKE MACH NUMBER OF 0.068

Table III. Summary of Pumping Performance for Single-Nozzle Configurations, W*T*.44 max.

			 			
L/D S/D	7.57	5.57	4.57	4.0	3.0	2.0
ELLIPTIC TRANSITION				,		
-0.25	0.735	0.770	0.760	,	0.730	
0.0	0.745	0.755	0.760		0.730	
0.25	0.710	0.740	0.740		0.740	
0.50	0.69					
CONICAL TRANSITION						
-0.25				0.740	0.720	
0.0				0.745	0.735	
0.25				0.740	0.735	
STRAIGHT ENTRANCE						
0.0					0.580	0.520
0.25					0.690	0.660
0.50					0.700	0.690

ALL DATA FOR UPTAKE MACH NUMBER OF 0.068

Table IV. Summary of Pumping Performance for Four-Nozzle Configurations, $W*T*^{.44}$ max.

 $K_{\mathbf{M}}$

STACK ENTRANCE	7.57	5.57	4.57	4.0	3.0	2.0
ELLIPTIC TRANSITION CONICAL TRANSITION STRAIGHT ENTRANCE	1.005	1.006	1.010	1.018	1.038 1.036 1.022	1.083

Table V. Mixing Performance for Four-Nozzle Configurations, $\mathbf{K}_{\mathbf{m}}.$

V_{MAX}/V_{AVG}

L/D	9.07	8.07	6.07	5.07	4.07	3.07	4.0	3.0	2.0
ELLIPTIC TRANS. S/D = 0	1.17	1.20	1.37	1.48	1.62	1.77			
STRAIGHT ENTRANCE S/D=0.25							1.78	1.86	1.99

(a) Single-Nozzle Configurations

V_{MAX}/V_{AVG}

STACK L/D ENTRANCE	7.57	5.57	4.57	4.0	3.0	2.0
ELLIPTIC TRANSITION	1.08	1.091	1.140		1.330	
CONICAL TRANSITION		:		1.180	1.330	
STRAIGHT ENTRANCE	•				1.140	1.570

(b) Four-Nozzle Configurations

Table VI. Mixing Performance, $V_{\text{max}}/V_{\text{avg}}$.

B

DATA TAKEN 17 MAY 77 BY PETE HARRELL

UNE NUZZLE, ELLIPTIC TRANSITION, STANDUFF 0.0

1/1/11.07/0/15

													UPT MAC		0.083	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0,082	0.082
25	REA	HES)											n	(FT/SEC)	16.86	98.57	98.44	98.25	98.20	98.18	98.16	98.17	98.14	98.14
3.00 INCHES 3.00 2.154 INCHES 70 29.96 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	1.767	3.142	6.284	9.621	11.585	13.548	15.512	17.081	****	ž	(FT/SEC)	16.86	129.95	143.15	156.44	160.90	162.25	163.05	163.69	163.06	*****
R: 3 /AP: ER: 0.70	PA-PN2	ER.)	7.10	3.73	5.39	1.01	0.50	0.36	0.27	0.21	0.17	0.0	a	(FT/SEC)	296.93	295.74	295.34	294.17	294.62	294.55	294.48	294.52	294.45	294.45
UPTAKE DIAMEȚER: 3 AKEA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	7.10	3.73	2.39	1.01	0.50	9.36	0.27	0.21	11.0	0.0	Z.	Ξ		0.116	991.0	0.215	0.232	762.0	0.240	0.242	0.240	****
5 4 5 5 4	PU-PA	CENC	1.60	10.90	12.10	13.60	14.00	14.20	14-30	14.30	14.40	14.50	3	(LBM/SEC)	0.328	0.330	0.330	0.331	0.331	166.0	0.331	0.331	Ó.331	0.331
	TAMB	NHE E T)	10.0	10.0	70.0	70.0	0.07	10.0	10.0	10.07	10.07	10.0	77 ## #7		0.0	0.3345	0.4753	0.6170	0.6643	0.6786	0.6873	0.6939	0.6875	******
ES	TUPT	(DEGREES FAHRENHEIT)	139.0	139.0	139.0	139.0	139.0	139.0	139.0	139.0	139.0	139.0	04/14		0.4062	0.2151	0.1382	0.0586	0.0291	0.0209	0.0157	0.0122	0.0099	0.0
1GZZLES: 1 1ETER: 1.732 INCHES 1; 33.21 INCHES 1ER: 3.00 INCHES 11.07	10R	(DEG	139.0	139.0	139.0	139.0	139.0	1 29.0	139.0	139.0	139.0	139.0	÷	<u>.</u>	0.8847	0.8847	0.8847	0.8847	0.8847	0.8847	0.8847	0,8847	6.8847	0.8847
Y NGZZLES: DIAMETER: NGTH: 33.21 AMETER: 3.11.07	DPOR	CF WATER)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	ż	Ł	0.3594	0.1903	0.1223	0.0519	0.6257	0.0185	0.0139	0.0108	0.0088	0.0
NUPBER OF PRIMARY NGZZLES: PRIMARY NOZZLE DIAMETER: 1. MIXING STACK LENGTH: 33.21 PIXING STACK DIAMETER: 3.4 MIXING STACK LO	PUR	(INCHES CF	16.6	15.9	21.2	22.6	23.0	23.2	. 23.2	23.3	23.3	23.5	• !	r K	0.0	0.3530	0.5016	0.6511	9-7011	0.1162	0.7253	0.7323	0.7255	****
PRIMA MIXIN MIXIN	z	RUN	-	۰ ~	ı m	4	s	. •0	~	8	. 6	10	;	z	.	. 2	ı m	. 4	ď	. •0	7	• •	6	10

0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 (a) S/D = 0.0, M = 0.082 MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10 0.0 5.0 4.0 0.0 3.0 0.0 PHSCIN. H20): :0/x

Table VII. Single-Nozzle Performance Data for L/D = 11.07, Elliptic Transition

HARRELL
PETE
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TAKEN
DAKA

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																			UPT MACH	_	0.068	0.068	0.067	190.0	190.0	190.0	190.0	190.0	0.067	,
				S		S HG	AREA	NCHES)		19	45	84	21	85	48	12	81	*	3	(FT/SEC)	81.04	80.82	80.72	80.63	80.61	80.60	80.58	80.58	80.59	
		3.00 INCHES	3.00	2.154 INCHES		29.96 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	1.767	3-142	6.284	9.621	11.585	13.548	15.512	17.081	*****	¥5	(FI/SEC)	91.04	106.38	117.39	127.63	132.27	132.87	133.52	134.04	135.09	
					TA: 0.70		PA-PNZ	TER)	4.68	2.48	19-1	99.0	0.34	0.24	0.18	0-14	0.12	0.0	ОP	(FT/SEC)	243.13	242.48	242.18	16.142	241.85	241.83	241.77	241.77	241.80	
		UPTAKE DIAMETER:	AREA RATIO, AM/AP:	ORIFICE DIAMETER:	ORIFICE BETA: 0.70	AMBIENT PRESSURE:	PA-PS	INCHES OF WATER!	4.68	2.48	19-1	99-0	0.34	0.24	0.18	0-14	0.12	0.0	SW.	(LBM/SEC)	0.0	0.095	0.136	0.174	0.191	961.0	0.196	0.198	0.202	
	01/0/	~	`	J	_		PU-PA	CINC	2.00	7.20	8.10	9.00	9.30	9.40	9.50	9.50	9.50	09-6	МР	(LBM/SEC)	0.268	0.269	0.269	0.269	0.269	0.270	0.270	0.270	0.270	
· .	01/0/10-11/1/1						TAMB	NHEIT)	70.0	70.0	70.0	10.0	0.07	10.0	70.0	10.0	10.0	70.0	75***I*M		0.0	0.3350	0.4794	0.6133	0.6736	0.6814	0.6901	8969-0	0.7103	
	0.0		ES				TUPT	(DEGREES FAHRENHEIT)	137.0	137.0	137.0	137.0	137.0	137.0	157.0	137.0	137.0	137.0	*1/*d		0.3980	0.2121	0-1380	0.0567	0.0292	0.0206	0.0155	0.0120	0.0103	
11 11444	IION, STANOOFF		1-732 INCH	33.21 INCHES	R: 3.00 INCHES		10R	(DEG	137.0	137.0	137.0	137.0	137.0	137.0	137.0	137.0	137.0	137.0	*		0.8877	0.8877	0.8877	0.8877	0.8877	0.8877	0.8077	0.8877	0.8877	
		RY NOZZLES:	CIAMETER:		APETER: 3	0: 11.07	DPCR	CF WATER!	10.0	10.0	0.01	10.0	10.0	0.01	10.0	10.0	10.0	10.0	* d		0.3533	0.1882	0.1225	0.0503	0.0259	0.0183	0.0137	0.0107	0.0092	,
:	ONE MOZZLE, ELLIPTIC TRANS	NUMBER OF PRIMARY NO	PRIMARY NOZZLE CIAMETER: 1.732 INCHES	MIXING STACK LENGTH:	MIXING STACK DIAPETE	PIXING STACK L/D:	PCR	(INCHES OF W	11.1	13.3	14-1	15.0	15.4	15.5	15.5	15.5	15.6	15.6	*		0.0	0.3530	0.5052	0.6463	6501-0	0.7181	0.7272	0.7343	0.7485	
	E NOZZLE,	NUMBE	PRIMA	MIXIN	NIXIN .	YIXIY	z	RUN	-	8	m	4	Ŋ	•9	1	80	6	01	z	RUN	~	2	M	4	'n	9	2	\$	6	

X/D: PHS(IN. fi20): PHS*:

Table VII. Continued.

DATA TAKEN 17 MAY 77 BY PETE HARRELL

W.

ONE NOZZLE, ELLIPTIC TRANSITION, STANDOFF 0.0 1/j/11.07/0/05

AMBIENT PRESSURE: 29.96 INCHES HG ORIFICE DIAMETER: 2.154 INCHES UPTAKE DIAMETER: 3.00 INCHES AREA RATIU, AH/AP: 3.00 ORIFICE BETA: 0.70 PRIMARY NOZZLE CIAMETER: 1.732 INCHES MIXING STACK DIAPETER: 3.00 INCHES MIXING, STACK LENGTH; 33.21 INCHES NUMBER OF PRIMARY NOZZLES: MIXING STACK L/D: 11.07

0.048 0.048 0.048 0.048 0.048 0.048 0.048 0.048 0.048 51.65 57.57 57.54 51.45 51.44 57-44 51.44 57.43 57.45 57.58 (SQUARE INCHES) SECONDARY AREA 14.081 1-767 11.585 13.548 3-142 6.284 9.621 15.512 ***** (FT/SEC) 89.95 92.92 51.65 82.91 93.65 95.27 15.51 95.02 ***** (LBM/SEC) (LBM/SEC) (FT/SEC) 172.72 172.75 172.32 172.95 172-63 172.36 172.36 172.32 172.30 PA-PNZ 172.32 0.12 10.0 0.77 0.09 90.0 (INCHES OF WATER) 990.0 0.094 0.120 0.131 0.138 0.140 0.142 0.134 ***** 0.0 0.12 PA-PS 1.22 0.77 60.0 0.32 0.07 0-150 0.189 0.189 0.190 0.189 0-10 0.190 0.190 3.60 4-10 4.60 4-70 4.80 4.80 4.80 4.80 4.90 74.4.44 0.4700 0.6555 0.6990 0.7127 0.6009 0.6692 0.6925 ****** 0.3329 72.0 72.0 72.0 72.0 72.0 72.0 72.0 (DEGREES FAHRENHEIT) 0.0 0.0102 0.2059 0.0271 0.0533 0.0195 0.0119 0.3923 0.1301 0.0152 138.0 138.0 137.0 137.0 137.0 p*/T* 137.0 140.0 137.0 137.0 0.8911 0.8896 0.8911 0.8866 0.8896 0.8896 0.8911 0.8911 0.8911 0.8911 138.0 138.0 138.0 137.0 137.0 140.0 137.0 137.0 137.0 137.0 * IINCHES CF WATER! 0.1832 0.0475 0.024i 0.0173 0.0135 1600.0 0.0106 0.3489 0.1157 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 0.3505 0.7498 0.4948 0.6322 0.6896 0.7040 0.7302 0.7354 ***** 7.8 7.2 R G N

0.0 0.0 (c) S/D = 0.0, $M_u = 0.048$ 0.0 0.0 0.9 0.0 MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10 2.0 0.0 0.0 4.0 0.0 3.0 0.0 0.0 0.0 0.0 PMS(1N. H20): PHS*:

Table VII. Continued.

DATA TAKEN ON 20 MAY 77 BY PETE HARPELL

1/1/11.07/-084/15 ONE NOZZLE, ELLIPTIC TRANSITION, STANDOFF -0.84

														UPT MACH		0.083	0.082	0.082	0.382	0.082	0.082	0.082	0.082	0.082	0.082
	H6	AREA	CHES)		ĸ	•	8	•	7	60	2	2		3	(FT/SEC)	59.29	99.10	98.96	98.76	98.86	98.84	98.56	98.56	56.56	96.39
3.00 INCHES 3.00 2.154 INCHES	29.96 INCHES HG	SECONDARY AREA	(SOUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.062	****	¥	(FT/SEC)	99.29	115.56	129.83	141.75	152.09	156.13	157.00	157.38	159.40	****
m 0		PA-PNZ	TER!	06.9	5.25	3.63	2-22	0.85	0.42	0.22	0.17	0.15	0.0	an	(FT/SEC)	297.89	297.31	296.91	296.30	296.61	296.53	295.69	295.69	295.69	295.20
UPTAKE DIAMETER: 3 AREA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70	AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	6.93	5.25	3.63	2.22	0.85	0.42	0.22	0.17	0.15	0.0	Şŧ	(LBM/SEC)	0.0	0.061	0.115	0.160	0.198	0.213	0.217	0.218	0.226	*****
5 4 6 6	¥	PU-PA	CINC	7.70	9.20	10.30	11.30	11.90	12.10	12.30	12.30	12.30	12.40	d#	(LBM/SEC)	0.327	0.328	0.328	0.329	0.329	0.329	0.330	0.330	0.330	0.330
		TAMB	NHEIT)	0.69	69.0	0.69	0.69	69.0	0.69	0.69	0.69	0.69	69.0	75.**1*X		0.0	0.1767	0.3304	0.4588	0.5675	0.6106	0.6220	0.6261	0.6476	******
£S		TUPT	(NECREES FAHRENHEIT)	143.0	143.0	143.0	142.0	144.0	144.0	141.0	141.0	141.0	139.0	P*/T*		0.3948	0.3016	0.2091	0.1282	0.0491	0.0243	0.0127	0.0098	0.0087	0.0
2LES: 1 ER: 1.732 INCHES 33.21 INCHES : 3.00 INCHES		TOR	(DEC	143.0	143.0	143.0	142.0	144.0	144.0	141.0	141.0	141.0	139.0	‡.		0.8772	0.8772	0.8772	0.8787	0.8758	0.6758	1088.0	1088.0	0.8801	0.8831
RY NOZZLES: DIAHETER: 1 NGTH: 33.21	0: 11.07	DPOR	IF WATER!	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	* d		0.3464	0.2646	0.1834	0.1126	0.0430	0.0213	0.0112	0.0087	0.0076	0.0
NUMBER OF PRIMARY NOZZ PRIMARY NOZZLE DIAHETE MIXING STACK LENGTH; 3 MIXING STACK DIAMETER;	MIXING STACK L/D: 11.07	POR	(INCHES OF WATE	16.7	18.1	19.2	20.2	20.9	21.1	21.2	21.2	21.2	21.4	*		0.0	C.1872	0.3500	0.4857	9109.0	6.6473	0.6580	0.6622	0.6850	*****
NUMBER PRIMAF MIXINC MIXINC	MIXIM	z	RUN	7	8	m	4	'n	9	7	80	Φ	10	z	RUN	-	2	ю	4	v	9	1	80	6	10

7.0 0.30 0.02 5.0 6.0 -0.95 -0.20 -0.05 -0.01 MIXING STACK PRESSURE DISTRIBUTION FOR RUK: 10 -2.30 4.0 -4.50 3.0 **** 0.0 X/D: PMS(IN. H2O): PMS*:

-0.59

(d) S/D = -0.84, $M_u = 0.082$

09.0 0.03

8.0 0.55 0.03

0.6

Table VII. Continued.

	1/1/11.07/-084/10
	-0.84
DATA TAKEN ON 20 MAY 77 BY PETE HARRELL	ONE NDZZLE, ELLIPTIC TRANSITION, STANDOFF -5.84
BY PETE	ISE TI ON.
11	TRAN
O MA)	PTIC
ON 2	ELLI
1 TAKEN	10 Z Z L E +
DAT	ONE

																		UPT MACH		0.048	0.068	0.06	0.067	0.067	0.067	190.0	0.067	0.067	0.067	
			FG		4.7	CHES		10	~	~	•	4	•	~	~	•		nn	(FT/SEC)	81.22	91.15	81.04	66.09	10.54	80.93	86.92	PC.52	80.92	(o · o · o	
3.00 INCHES	2.154 INCHES		29.96 INCHES FG		SECONDARY AFEA	(SOUARE INCHES)	0.0	0.785	1.767	3.142	6.2E4	9.621	13.548	15.512	17.082	*******		N O	(FT/SEC)	81.22	15.46	106.32	116.11	124.56	127.75	130.77	130.35	17 06.	10.00	
TER: 3.00		0.70	SURE: 29		PA-PN2		4.60	3.50	2.43	1.48	0.57	0.28	0.16	0.12	0.10	9	2	å	(FT/SEC)	243.68	243.38	243.14	243.00	242.85	242.82	242.79	242.79	61.542	242.19	9/ 542
UPTAKE DIAMETER:	AREA RATIO, AM/AP.	ORIFICE BETA: 0.70	AMBIENT PRESSURE:		PA-PS	(INCHES OF WATER)	4.60	3.50	2.43	1.48	0.57	0.28	0.16	0.12	0.10		•	S#	(LBM/SEC)	0.0	0.050	0.094	0.130	0.162	0.174	0.185	601	0.183	0.184	•
dn :	AR o	5 8	¥		PU-PA	LINCH	5.10	6.10	6.90	7.40	7.90	8.00	8.10	8.10	01.8		07.8	a.	() HM / SEC)	L 267	0.268	0.268	0.268	0.268	0.268	348	003.0	0.268	0.268	0.268
					TAMB	HEIT	70.0	70.0	10.0	10.0	70.0	70.0	70.0	70.0		2	10.0	77°**L*N		0	0.1771	918	0.2020	0.5709	201710	0.000	6160.0	0.6464	0.649R	*****
	v				TUPT	(DEGREES FAHRENHEIT)	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0		0.041	140.0	4T/ 40		2105.0	2985	7202 0	1102.0	0071.0	0000	0.000	0.013/	0.0103	0.0086	0.0
-	PRIMARY NOZZLE CIAMETER: 1.732 INCHES	3.21 INCHES .	3.00 INCHES		TOR	CDEGR	0.041	140.7	140.0	140.0	140.0	140.0	140-0	0 0 7 1	0.011	0.041	140.0	;	<u>•</u>	0000	0.0033		0.6833	0.8833	0.8000	0.8833	0.8833	0.8833	0.8833	0.8833
NOZZEES:	AMETER: 1	๓	7	10.11	audo	T TATER	10.0	0.01	0.01		0.00		0.01	0.01	70.0	10.0	10.0	i	*		0.5457	1.502.0	0.1834	0.1119	0.0431	0.0212	0.0121	0.0091	0.0076	0.0
NUMBER OF PRIMARY NOZZLES:	. NO 2 2 L E CI	MIXING STACK LENGTH: 3	MIXING STACK DIAMETER:	MIXING STACK L/U: 11.	900	TOTAL DE MATE	tinches of	1111	1.21	, ;;	13.4	6.5.3	7.	1 • • •	14-1	14.1	14.2		*	,	0-0	0.18/0	0.3505	0.4860	0.6029	0.6469	3.6885	0.6827	0.6863	*****
NUMBER	PRI MARY	MI X ING	MI XING	MIXING	;	z ;	XO.	(~ •	n .	+ 1	ν.	() 1	-	8	6	10		z	RUN	-	7	m	*	S.	9	7	8	٥	01

(e) S/D = -0.84, $M_u = 0.068$ 8.0 0.45 7.0 0.30 0.02 00.00 MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10 -0.39 ۳. 0 4.0 3.0 -2.75 -0.21 0.0 -0.58 X/0: PMS(IN. H20): PMS*:

Table VII. Continued.

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DATA TAKEN ON 20 MAY 77 BY PETE HARRELL

ONE NO22LE. ELLIPTIC TRANSITION. STANDOFF -0.84 1/1/11.07/-084/05

																	UPT MACH		0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
				91	AREA	CHES)		u 1	1	~	•			~	~	•	an	(FT/SEC)	57.49	57.46	57.44	57.46	57.44	57.44	57.44	57.44	57.44	57.43
3.00 INCHES	3.00	2.154 INCHES		29.96 INCHES HG	SECONDARY AREA	(SOUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.546	15.512	17.082	****	¥	(FT/S EC)	57.49	96.99	15.07	81.80	87.49	89.36	93.43	90.92	92.60	****
			BETA: 0.70		PA-PNZ	WA TER)	2.30	1.74	. 1.18	0.71	0.27	0.13	0.07	0.05	0.05	0.0	ď	(FT/SEC)	172.49	172.39	172.32	172.39	172.34	172.32	172.32	172.32	172.32	172.30
UPTAKE DIAMETER:	AREA RATIO, AM/AP:	DRIFICE DJAMETER:	ORIFICE BET	AMBIENT PRESSURE:	PA-PS	INCHES OF MAT	2 • 30	1.74	1.18	0.71	0.27	0.13	10-0	0.05	9.05	0.0	HS	(LBM/SEC)	0.0	0.035	0.065	0.090	0.111	0.118	0.122	0.124	0.130	*****
ם	•	0	0	•	PU-PA	(INC	2.60	3.10	3.40	3.80	4.00	4.10	4.10	4.10	4.10	4.20	3	(LBM/SEC)	0.190	0.190	0.190	0.190	0.190	0.190	0.190	0.190	0.190	0.190
					TAMB	NHEIT	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	55***1*B		0.0	0.1767	0.3275	0.4515	0.5567	4165.0	0.6111	0.6202	0.6512	*****
	ES				TUPT	(DEGREES FAHRENHEIT)	135.0	135.0	135.0	136.0	136.0	136.0	136.0	136.0	136.0	136.0	D*/T*		0.3873	0.2934	0.1991	9.1199	0.0456	0.0220	0.0118	0.0093	0.0085	0.0
	1.732 INCH	3.21 INCHES	3.00 INCHES		T 08	(066	135.0	135.0	135.0	136.0	136.0	136.0	136.0	136.0	136.0	136.0	*		0.8924	0.8924	0.8924	0.8909	0.8909	6068*0	0.8909	0.8309	0.8909	0.8909
RY NOZZLES	DIAMETER:	NGTH; 33.2		0: 11.07	DPOR	OF WATER!	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	*		0.3456	0.2618	0.1777	0.1068	0.0406	9610.0	0.0105	0.0083	0.0075	0.0
NUMBER OF PRIMARY NOZZLES:	PRIMARY NOZZLE DIAMETER: 1.732 INCHES	MIXING STACK LENGTH; 3	MIXING STACK DIAMETER:	MIXING STACK L/D: 11.	POR	(INCHES OF WATE	5.6	6.1	4.9	6.8	7.0	7.1	7.1	7.1	7.1	. 7.2	*		0.0	0.1858	0.3443	0.4750	0.5857	0.6222	0.6429	0.6525	0.6851	*****
NUMBE	PRIMA	MIXIM	MIXIN	HI XIV	z	RUN	-	7	m	4	'n	•	7	80	6	10	z	RUN	1	7	6	4	v	•	7	80	6	01

MIXING STACK PRESSURE DISTRIBUTION FOP PLUN: 19

90.0 0.40 0.8 0.05 0.30 7.0 6.0 0.15 0.02 9.0 0.0 0.0 -0.50 -0.08 4.0 -1.20 -0-18 -4.75 -0-72 0.0 X/D: PMS(IN. H2G): PMS*:

(f) S/D = -0.84, $M_u = 0.048$ Table VII. Continued.

DATA TAKEN 30 MAY 17 BY PETE HARRELL

													UPT MACH		0.083	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
	£	NREA CHES 1		**	~	(%	.•	_	.	N.	~		ກຸລ	(FT/SEC)	12.56	94.55	98.36	. 02.66	99-04	20.66	\$0.55	99.03	60.66	10.22
	3.00 INCHES 3.00 2.154 INCHES 0 29.87 INCHES HG	SECONDARY AREA	0.0	0.785	1.767	3.142	6.284	9.621	13.546	15.512	17.082	***	HO	(FT/SEC)	11.66	115.61	129.58	141.82	153.47	158.17	161.10	160.91	161.63	*****
	ETER: 3.0 AM/AP: 3 METER: 2. A: 0.70 SSURE: 29	PA-PNZ	7.00	5.10	3.51	2.20	06.0	0.45	0.25	0.19	0.16	0.0	9	(FT/SEC)	299.14	298.41	298.10	297.63	297.12	297.22	297.15	297.12	297.12	297.04
	UPTAKE DIAMETER: 3 AREA RATIO, AH/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIENT PRESSURE:	PA-PS PA	7.00	5.10	3.51	2.20	06.6	0.45	0.25	0.19	91.0	0.0	#S	(LBM/SEC)	0.0	0.061	0.113	0.159	0.203	0.221	0.232	0.231	0.234	*****
100/15		PU-PA	7.60	09.6	11.10	12.40	13.80	14.20	14.40	14.50	14.50	14.60	3	(LBM/SEC)	0.326	0.327	0.327	0.328	0.328	0.328	0.328	0.328	0.328	0.328
1/1/9.57/100/15		TAMB	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	77.**T*W		0.0	0.1742	0.3248	0.4565	0.5814	0.6310	0.6621	0.6608	0.6678	*****
1.00	π «	TUPT TAM	146.0	146.0	147.0	147.0	147.0	148.0	148.0	148.0	148.0	148.0	*1/*d		0.4005	0.2932	0.2025	0.1273	0.0520	0.0262	9.0145	0.0111	0.0093	0.0
STANDOFF	ES: 1 1.732 INCH 1.71 INCHES 3.00 INCHES	TOR 200	146.0	146.0	147.0	147.0	147.0	148.0	148.0	148.0	148.0	148.0	* #		0.8663	6998-0	0.8648	0.8648	0.8648	0.8634	0.8634	0.8634	0.8634	0.8634
RANSITION,	AY NOZZLES DIAMETER: NGTH: 28.7 AMETER: 3	POR DPOR	15.0	15.0	15.0	15:0	15.0	15.0	15.0	15.0	15.0	15.0	*		0.3469	0.2540	0.1752	0.1101	0.0450	0.0226	0.0126	0.0095	0.0080	0.0
ELLIPTIC T	NUMBER OF PRIMARY MOZZLES: 1 PRIMARY NOZZLE DIAMETER: 1.732 INCHFS MIXING STACK LENGTH: 28.71 INCHES MIXING STACK OLAMETER: 3.00 INCHES	POR	16.6	18.6	20.1	21.4	22.8	23.2	23.4	23.5	23.5	23.5	3		0-0	0.1856	0.3462	0.4866	0.6198	0.6731	0.7063	0.7049	0.7123	*****
ONE NOZZLE, ELLIPTIC TRANSITION, STANDOFF 1.00	NUMBE PRIMA MIXIN MIXIN	z	5 ~	۰ ۸	ิต	4	s	9	1	80	6	10	z	RUN	-	. 2	m	4	'n	9	7	80	٥	10
ð																								

0.0 MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 0.0 0.0 0.0 0.0 X/D: PMS (1N- H2O): PMS*:

Table VIII. Single-Nozzle Performance Data for L/D = 9.57, Elliptic Transition (a) S/D = 1.0, $M_u = 0.082$

0.0

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TAKEN
DATA

ONE NOZZLE, ELLIPTIC TRANSITION, STANDOFF 1.00

1/1/9.57/100/10

																	UPT MACH		0.068	0.068	0.068	0.068	0.067	0.067	0.067	0.067	0.067	0.067
				HG	REA	CHES)		10	_	~		-	60	N.	2	•	nn	(FT/SEC)	61.65	81.56	81.53	e1.45	81.35	@1. 39	81.38	81.45	e1.44	96.08
3.00 INCHES	3.00	2.154 INCHES		25.87 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	5.621	13.548	15.512	17.062	*****	N O	(FT/SEC)	81.69	94.68	105.95	116.11	125.29	128.77	130.95	130.58	130.83	****
			A: 0.70		PA-PN2	ER)	4.60	3.38	2.30	1.46	0.59	0.29	0.16	. 0.12	0.10	0.0	d)	(FT/SEC)	245.09	544.69	244.60	244.35	244.06	244.20	244.17	244.37	244.34	242.90
UPTAKE DIAMETER:	AREA RATIO, AM/AP:	DRIFICE DIAMETER:	DRIFICE BETA: 0.70	AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	4.60	3.38	2.30	1.46	0.59	0.29	0.16	0.12	0.10	0.0	S#	(LBM/SEC)	0-0	0.049	0.092	0.130	0.164	771.0	0.185	0.184	0.185	*****
ă	₹	Ö	Ō	₹	PU-PA	(INC	5.10	6-40	7.40	8.30	9.20	9.40	09.6	09.6	09.6	6.70	ğ	(LBM/SEC)	0.266	0.266	0.266	0.267	0.267	0.267	0.267	0.267	0.267	0.268
					TAMB	NHĖIT)	0.59	65.0	65.0	65.0	65.0	65.0	65.0	65.0	0.59	65.0	55***1*M	•	0.0	0.1741	0.3230	0.4570	0.5781	0.6231	0.6515	0.6460	0.6495	******
	S				TUPT	(DEGREES FAHRENHĖIT)	145.0	145.0	146.0	146-0	146.0	147.0	147.0	148.0	148.0	141.0	P*/T*		9166.0	0.2885	0.1968	0.1252	0.0503	0.0249	0.0138	0.0103	0.0086	0.0
-	1.732 INCHE	INCHES	3.00 INCHES		T0R	(DEG	145.0	145.0	146.0	146.0	146.0	147.0	147.0	148.0	148.0	141.0	<u>*</u>		0.8677	0.8677	0.8663	0.8663	0.8663	0.8648	0.8648	0.8634	0.8634	0.8735
Y NOZZLES	IAMETER: 1	1GTH; 28.7		2.	DPOR	JE WATER)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	0.01	å		0.3396	0.2503	0.1705	0.1084	0.0436	3.0216	0.0119	0.0089	0.0074	0.0
NUMBER OF PRIMARY NOZZLES:	PRIMARY NOZZEE DIAMETER: 1.732 INCHES	MIXING STACK LENGTH; 28.71 INCHES	MIXING STACK DIAMETER:	MIXING STACK L/D:	aca	(INCHES OF WATE	11-1	12.4	13.4	14.4	15.2	15.4	15.7	15.7	15.6	15.7	*	•	0.0	0.1854	0.3441	0.4868	0.6158	0.6642	9469.0	0.6892	0.6929	***
NUMBER	PRIMA	MIXIM	MIXIN	MIXIM	2	. Š	=	. 4	ı m	. 4	'n	9	7	80	6	10	z	. N	-	. ~	ı m	. 4	· w	. •0	~	· 90	• •	10

X/D: 0.0 0.5 3.0 4.0 5.0 IN. H201: -0.72 -0.51 0.12 0.22 0.14 PHS*: -0.05 -0.04 0.01 0.02 0.01 X/D: PHS(IN. H2O): PHS*:

8.0 0.34 0.03 (b) S/D = 1.0, $M_u = 0.068$ 0.06 0.09

Table VIII. Continued

DATA TAKEN 30 MAY 77 BY PETE HARRELL

ONE NOZZLE, ELLIPTIC TRANSITION, STANDOFF 1.50

1/1/9.57/100/05

Table VIII. Continued.

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ACTIVATION OF THE PROPERTY OF

DATA TAKEN 27 MAY 77 BY PETE HARRELL

21/0/12-6/1/1 ONE NOZZLE, ELLIPTIC TRANSITION, STANDOFF 0.0

																	5										
				HG	IREA	CHES)		6	_	A 1			~ 1	•	•	_	3	(FT/SEC)	64.65	95.58	99.48	99.31	55.25	99.26	55.23	56.23	06.00
3.00 INCHES	2.00	2.154 INCHES		29.87 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.264	9.621	13.540	15.512	17.082	****	ž	(FT/SEC)	99.79	116.04	130.70	144.12	156.69	161.46	163.61	164.37	143.77
:	•	METER:	A: 0.70		PA-PNZ	ER 1	7.10	5.32	3.76	2.44	1.00	0.50	0.27	0.21	0.17	0.0	a n	(FT/SEC)	299.39	298.76	298.46	297.95	297.76	297.78	297.71	298.20	000
UPTAKE DIAMETER:	AKER KALLUP BEJAP.	ORIFICE DIAMETER:	DRIFICE BETA: 0.70	AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	7.10	5.32	3.76	2.44	1.00	0.50	0.27	0.21	0.17	0.0	HS	(LBM/SEC)	0.0	29000	0.117	0.168	0.215	0.233	0.241	0.243	176 0
5 4	ž (Ē	ō	₹	PU-PA	(INC	7.60	9.30	10.80	12.20	13.40	14.00	14.20	14.20	14.20	14.40	ďĦ	(LBH/SEC)	0.326	0.326	0.327	0.327	0.327	0.327	0.327	0.327	
					TAMB	WEIT)	64.0	0.49	0-59	0-+9	6.49	64.0	0.49	0**9	0.49	0.49	44. 44T W		0.0	0.1783	0.3363	0.4810	0.6151	0.6655	0.6884	0.6953	0007
Ų	ņ				TUPT	(DEGREES FAHRENHEIT)	147.0	147.0	146.0	148.0	149.0	150.0	150.0	152.0	152.0	152.0	p*/T*		0.4062	9-3056	0.2168	0.1412	0950.0	0.0291	0.0157	0.0122	
73.7 18/5 10	Targaret	INCHES	OO INCHES		1 08	(DEG	147.0	147.0	148.0	148.0	149.0	150.0	150.0	152.0	152.0	152.0	*		0.8632	0.8632	0.8618	0.8618	9.8604	0.8589	0.8589	0.8561	0 956.1
MAFY NOZZLES: 1	יושעוני ביי	LENGTH: 28.71 INCHES	DIAMETER: 3.00 INCHES	15.6 :1	DPOR	OF WATER!	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	*		9056.0	0.2638	0.1868	0.1217	0.0499	0.0250	0.0135	0.0105	2000
NUMBER OF PRIMAR			MIXING STACK DIA	HIXING STACK L/D:	POR	(INCHES 0	16.6	18.3	19.8	21.2	22.4	23.0	23.2	23.2	23.2	23.4	*		0.0	0.1899	0.3591	0.5135	0.6571	0.7115	0.7361	0.7445	0.7376
NUMBER		SNIX IN	MIXING	HIXING	z	RUN		2	м	4	'n	9	7	80	6	10	z	RUN	-	2	9	4	'n	ý	2	83	o

UPT HACH

0.083 0.082 0.082

0.082 0.082 0.082 0.082

0.082

66.69 99.37

163.77 *****

298.13

0.327 0.327 0.327

0.8561 0.8561

0.7376 *****

0.0

0.0

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

(d) S/D = 0.0, $M_u = 0.082$ 0.0 7.0 0.0 5.0 4.0 0.0 3.0 0.0 0.0 0.0 PMS(IN. H20):

Table VIII. Continued.

DATA TAKEN 27 HAY 77 BY PETE HARRELL

ONS NOZZLE, ELLIPTIC TRANSITION, STANDOFF 0.0

1/1/9.57/0/10

NITING STACK LENGTH; 28.71 INCHES NITING STACK LACK LACK LACK STACK	Ž	MUMBER DE PRIMARY MUZZLES:	AKY MUZZLES				-	UPIAKE DIAMETER:	METER: 3	3.00 INCHES		
HIXING STACK LENGTH; 28.71 HWGHES HWIXING STACK LENGTH; 28.71 HWGHES HWIXING STACK LANGTER; 3.00 INCHES HWIXING STACK L/O: 9.57 HWGHER; 3.00 INCHES HWIXING STACK L/O: 9.57 HWIXING STACK L/O: 9.50 HW	PRI	HARY NOZZLE	DIAMETER:	1.732 INC	HES		•	REA RATIO	. AM/AP:	3.00		
NITING STACK CIAMETER: 3.00 INCHES NICHES NICHE	X I X	ING STACK LI	ENGTH: 28.7	71 INCHES			J	RIFICE DI		2.154 INCHES		
MIXING STACK L/O: 9-57 MIXING STACK L/O: 9-50 MIXING STACK L/O: 9-50 MIXING MIXING L/O: 9-50 MIXING MIXIN	MIX	ING STACK D	ER:	3.00 INCHES	14		_	DRIFICE BE	TA: 0.70			
Mathematical Notation Mat	Ĭ	ING STACK L.						MBIENT PR		25.86 INCHES	HG	
Mathematical Discription Total Discription	z	₽OR.	DPOR	TOR	TUPT	TAMB	PU-PA	PA-PS	PA-PN?	SECONDARY	ARES	
11.0 10.0 143.0 143.0 70.0 5.00 4.68 4.68 0.0 12.2 10.0 143.0 143.0 70.0 6.20 3.55 3.55 0.785 13.2 10.0 143.0 143.0 70.0 6.20 3.55 3.55 0.785 14.0 143.0 143.0 70.0 8.10 1.60 1.60 1.747 15.0 10.0 143.0 143.0 70.0 9.20 0.68 0.68 6.284 15.4 10.0 143.0 143.0 70.0 9.50 0.19 0.19 0.264 15.5 10.0 143.0 143.0 70.0 9.50 0.19 0.15 113.54 15.6 10.0 143.0 143.0 70.0 9.50 0.19 0.15 113.54 15.6 10.0 143.0 143.0 70.0 9.50 0.19 0.15 113.54 15.6 10.0 143.0 143.0 70.0 9.50 0.19 0.15 113.54 15.6 10.0 143.0 143.0 70.0 9.50 0.19 0.15 113.54 15.6 10.0 143.0 143.0 70.0 9.50 0.19 0.15 113.54 15.6 10.0 143.0 143.0 70.0 9.50 0.19 0.15 113.54 15.6 10.0 143.0 143.0 70.0 9.50 0.15 0.15 113.54 15.6 10.0 143.0 143.0 70.0 9.50 0.15 0.15 113.54 15.6 10.0 143.0 143.0 70.0 9.50 0.15 143.0 113.54 15.6 10.0 143.0 143.0 114.0 70.0 9.50 0.15 143.0 113.54 15.6 10.0 143.0 0.3981 0.184 0.267 0.184 0.167 123.54 123.4 113.54 0.156 0.126 0.186 0.0189 0.018	RUN	(INCHES	OF WATER)	050)	SPEES FAHR	ENHEIT)	NI)	HES OF WA	TER)	(SOUARE IN	CHESI	
12.2 10.0 143.0 143.0 70.0 6.20 3.55 3.55 0.185 13.2 10.0 143.0 143.0 70.0 7.20 2.48 2.48 1.767 13.4 10.0 143.0 143.0 70.0 8.10 1.60 1.60 3.142 15.0 10.0 143.0 143.0 70.0 9.20 0.08 0.08 0.284 15.4 10.0 143.0 143.0 70.0 9.20 0.19 0.19 0.154 15.5 10.0 143.0 143.0 70.0 9.50 0.19 0.19 11.546 15.6 10.0 143.0 143.0 70.0 9.50 0.19 0.19 11.546 15.6 10.0 143.0 143.0 70.0 9.50 0.19 0.19 11.546 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 11.546 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 11.546 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 11.546 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 11.546 15.6 10.0 0.3499 0.3789 0.3284 0.2864 0.2	~	11.0	10.0	143.0	143.0	70.0	5.00	4.68	4.68	0.0		
13.2 10.0 143.0 143.0 70.0 7.20 2.48 2.48 1.7t 14.1 10.0 143.0 143.0 70.0 8.10 1.60 1.60 3.142 15.4 10.0 143.0 143.0 70.0 8.10 0.48 0.68 6.284 15.4 10.0 143.0 143.0 70.0 9.50 0.13 0.15 0.15 15.5 10.0 143.0 143.0 70.0 9.50 0.14 0.15 0.15 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 17.082 15.6 10.0 0.3499 0.8789 0.3981 0.0 0.267 0.267 0.095 244.78 91.57 81.57 0.3568 0.0510 0.8789 0.1371 0.4792 0.267 0.136 243.48 135.44 81.14 0.7509 0.0114 0.8789 0.0152 0.7094 0.268 0.10 243.42 135.54 81.14 0.7509 0.0114 0.8789 0.0152 0.7095 0.268 0.201 243.42 135.54 81.14 0.7509 0.0104 0.8789 0.0163 0.7095 0.268 0.201 243.42 135.54 81.14 0.7509 0.0104 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.54 81.14 0.7509 0.0014 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.56 81.14 0.7509 0.0014 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.56 81.14 0.7509 0.0014 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.56 81.14 0.7509 0.0014 0.8789 0.0013 0.7003 0.7003 0.201 243.42 135.56 81.14 0.7509 0.0004 0.8009 0.0003 0.00	8	12.2	10.0	143.0	143.0	70.0	6.20	3.55	3.55	0.78	ĸ,	
14.1 10.0 143.0 143.0 70.0 8.10 1.60 1.60 3.142 15.0 10.0 143.0 143.0 70.0 9.00 0.68 0.68 6.284 15.4 10.0 143.0 143.0 70.0 9.30 0.34 0.34 9.421 15.4 10.0 143.0 143.0 70.0 9.50 0.13 0.19 13.516 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 13.516 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 13.516 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 13.516 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.00 0.00 0.00 15.6 10.0 143.0 0.3981 0.2862 0.286 0.26 244.36 95.01 81.57 0.3568 0.0310 0.8789 0.0329 0.1784 0.267 0.136 0.191 243.48 132.84 81.14 0.7509 0.0144 0.8789 0.0163 0.7094 0.268 0.201 243.39 132.84 81.14 0.7509 0.0144 0.8789 0.0163 0.7094 0.268 0.201 243.32 135.54 81.14 0.7509 0.0140 0.8789 0.0125 0.7095 0.268 0.201 243.35 135.56 81.14 0.7509 0.0140 0.8789 0.0125 0.7095 0.268 0.201 243.35 135.56 81.14 0.7509 0.0101 0.8789 0.0103 0.7107 0.268 0.201 243.35 135.54 81.14 0.7509 0.0014 0.8789 0.0103 0.7107 0.268 0.201 243.35 135.56 81.14 0.7509 0.0014 0.8789 0.0103 0.7107 0.268 0.201 243.35 135.54 81.14 0.7509 0.0014 0.8789 0.0103 0.7107 0.268 0.201 243.35 135.54 81.14 0.7509 0.0014 0.8789 0.0103 0.7107 0.268 0.201 243.35 135.54 81.14 0.7509 0.0014 0.8789 0.0103 0.7107 0.268 0.201 243.35 135.54 81.14 0.7509 0.0014 0.8789 0.0103 0.7107 0.268 0.201 243.35 135.54 81.14 0.7509 0.0014 0.8789 0.0103 0.7107 0.268 0.201 243.35 135.54 81.14 0.7509 0.0014 0.8789 0.0103 0.7105 0.201 243.35 135.34 81.14 0.7509 0.0014 0.0014 0.00	e	13.2	10.0	143.0	143.0	70.0	7.20	2.48	2.48	1.76	1	
15.0 10.0 143.0 143.0 70.0 9.00 0.68 0.684 15.4 10.0 143.0 143.0 70.0 9.30 0.34 0.34 9.621 15.5 10.0 143.0 143.0 70.0 9.50 0.19 0.19 113.54 15.6 10.0 143.0 143.0 70.0 9.50 0.15 0.15 15.512 15.6 10.0 143.0 143.0 70.0 9.50 0.15 0.15 15.512 15.6 10.0 143.0 143.0 70.0 9.50 0.15 0.15 15.512 15.6 10.0 143.0 143.0 70.0 9.50 0.15 0.15 17.5812 15.6 10.0 143.0 143.0 70.0 9.50 0.15 0.15 17.5812 15.6 10.0 143.0 143.0 70.0 9.50 0.15 17.5812 17.5812 15.6 10.0 143.0 143.0 70.0 70.0 70.0 74.74 11.5812 15.6 0.34.9 0.8789 0.3281 0.2264 0.05 244.38 13.57 81.57 0.4564 0.4864 0.48789 0.4121 0.4782 0.2268 0.191 243.48 135.84 81.18 0.7509 0.0114 0.8789 0.0125 0.0709 0.2288 0.0191 243.48 135.84 81.11 0.7509 0.0114 0.8789 0.0102 0.2288 0.228 0.228 0.239 135.54 81.11 0.7509 0.0110 0.8789 0.0102 0.4089 0.201 243.42 135.56 81.11 0.7509 0.0110 0.8789 0.0102 0.2488 0.201 243.42 135.56 81.11 0.7509 0.0110 0.8789 0.0102 0.2488 0.201 243.42 135.56 81.11 0.7509 0.0110 0.8789 0.0102 0.2488 0.201 243.42 135.56 81.11 0.7509 0.0110 0.8789 0.0102 0.2488 0.201 243.42 135.56 81.11 0.7509 0.0011 0.8789 0.0102 0.2488 0.201 243.42 135.56 81.11 0.7509 0.0011 0.8789 0.0102 0.2488 0.201 243.42 135.56 81.11 0.7509 0.0011 0.8789 0.0102 0.2488 0.201 243.42 135.56 81.11 0.7509 0.0011 0.8789 0.0102 0.2488 0.201 243.42 135.56 81.11 0.7509 0.0011 0.8789 0.0102 0.2488 0.201 243.42 135.56 81.11 0.7509 0.0011 0.8789 0.0102 0.2488 0.201 243.42 135.56 81.11 0.7509 0.0011 0.8789 0.0102 0.2488 0.201 243.42 135.56 81.11 0.7509 0.0010 0.8789 0.0010	4	14.1	10.0	143.0	143.0	70.0	8.10	1.60	1.60	3.14	7	
15.4 10.0 143.0 143.0 70.0 9.30 0.34 0.34 9.621 15.5 10.0 143.0 143.0 70.0 9.50 0.19 0.19 13.546 15.6 10.0 143.0 143.0 70.0 9.50 0.15 0.15 15.512 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 15.512 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 17.082 15.6 10.0 143.0 143.0 70.0 9.60 0.0 0.0 0.0 14.6 143.0 143.0 143.0 70.0 9.60 0.0 0.0 0.14 143.0 143.0 143.0 0.1844 144.4 144.4 144.4 144.4 144.4 144.4 144.4 0.1888 0.2662 0.8789 0.3789 0.2721 0.7864 0.267 0.136 244.74 117.82 181.45 0.2662 0.1265 0.8789 0.2721 0.4786 0.267 0.136 244.74 117.82 181.4 0.2663 0.0257 0.8789 0.0570 0.6760 0.268 0.191 243.48 135.34 131.8 0.7134 0.0257 0.8789 0.0163 0.7107 0.268 0.201 243.49 135.54 11.14 0.7509 0.0114 0.8789 0.0125 0.7109 0.268 0.201 243.42 135.56 11.14 0.7509 0.0114 0.8789 0.0125 0.7109 0.268 0.201 243.42 135.56 11.14 0.7509 0.0114 0.8789 0.0125 0.7109 0.268 0.201 243.42 135.56 11.14 0.7509 0.0114 0.8789 0.0105 0.7107 0.268 0.201 243.42 135.56 11.14 0.7509 0.0114 0.8789 0.0105	S	15.0	10.0	143.0	143.0	10.0	9.00	0.68	0.68	6.28	4	
15.5 10.0 143.0 143.0 70.0 9.50 0.19 0.19 13.24¢ 15.6 10.0 143.0 143.0 70.0 9.50 0.15 0.15 15.512 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.15 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.12 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.12 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.12 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.12 17.082 15.6 10.0 143.0 143.0 70.0 70.0 9.50 0.0 0.0 15.6 10.0 0.3499 0.3899 0.1184 0.264 0.267 0.264 0.267 17.82 16.75E 17.8E 0.5062 0.1264 0.8789 0.2121 0.4782 0.267 0.268 0.176 24.38 17.82 18.35 0.7509 0.014 0.8789 0.0163 0.7094 0.268 0.201 243.48 132.84 131.8 0.7509 0.0110 0.8789 0.0163 0.7094 0.268 0.201 243.42 135.54 131.8 0.7509 0.0110 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.54 131.4 0.7509 0.0110 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.66 81.14 0.7509 0.0110 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.66 81.14 0.7503 0.0091 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.66 81.14 0.7503 0.0091 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.66 81.14 0.7503 0.0091 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.66 81.14 0.7503 0.0091 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.66 81.14 0.7503 0.0091 0.8789 0.0103 0.7107 0.268 0.201 243.60 0.201	9	15.4	10.0	143.0	143.0	70.0	9.30	0.34	0.34	9.62	-	
15.6 10.0 143.0 143.0 70.0 9.50 0.15 0.15 15.512 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.12 17.082 17.082 15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.00 0.00 143.0 143.0 70.0 9.50 0.12 0.00 0.00 0.00 143.0 143.0 70.0 9.50 0.12 0.00 0.00 0.00 0.3499 0.3789 0.3981 0.266 0.266 0.026 0.4796 0.4782 0.267 0.267 0.056 0.4796 0.267 0.267 0.095 244.08 17.82 17.82 17.82 0.2588 0.257 0.3789 0.2582 0.257 0.268 0.267 0.268 0.176 243.81 17.82 17.82 17.82 0.2589 0.2889 0.2899 0.28	~	15.5	10.0	143.0	143.0	70.0	9.50	0.19	0.19	13.54	.	
15.6 10.0 143.0 143.0 70.0 9.50 0.12 0.12 17.082 17.082 15.6 10.0 143.0 143.0 70.0 9.60 0.0 0.0 0.0 17.082 17.082 143.0 143.0 70.0 9.60 0.0 0.0 0.0 143.0	8	15.6	0.01	143.0	143.0	70.0	9.50	0.15	0.15	15.51	8	
15.6 10.0 143.0 143.0 70.0 9.60 0.0 0.0 ************************	6	15.6	10.0	143.0	143.0	70.0	9.50	0.12	0.12	17.08	8	
N P* T* P*/T* M*T***,44 MP MS UP UH UH UU N 0.0 0.3499 0.8789 0.3981 0.0 0.266 0.0 244.74 81.57 61.57 0.1888 0.2662 0.8789 0.3029 0.1784 0.267 0.050 244.74 81.57 81.57 0.3562 0.1864 0.8789 0.3171 0.3552 0.267 0.065 244.38 95.01 81.45 0.5562 0.1205 0.8789 0.1371 0.4782 0.267 0.065 244.08 106.91 81.35 0.5568 0.0510 0.8789 0.1371 0.4782 0.267 0.135 243.61 117.82 81.18 0.7134 0.0257 0.8789 0.05740 0.6268 0.176 243.54 132.84 81.14 0.7509 0.0110 0.8789 0.0163 0.7094 0.268 0.191 243.54 135.66 81.14 <	01	15.6	10.0	143.0	143.0	70.0	9.60	0.0	0.0	*****	*	
Column C	z	ż	å	*	P*/T*	75"+*1*M	ā	H	ŝ	ŧ	3	UPT MAC
0.0 0.3499 0.8789 0.3981 0.0 0.266 0.0 244.74 81.57 81.57 0.1888 0.2662 0.8789 0.3029 0.1784 0.267 0.050 244.38 95.01 81.45 0.3548 0.1864 0.8789 0.2121 0.3352 0.267 0.095 244.08 106.91 81.45 0.5562 0.1205 0.8789 0.1371 0.4782 0.267 0.135 243.61 117.82 81.18 0.6568 0.0510 0.8789 0.0580 0.6726 0.268 0.176 243.54 128.72 81.18 0.7134 0.0257 0.8789 0.0163 0.6740 0.268 0.201 243.48 132.84 81.14 0.7509 0.0110 0.8789 0.0163 0.7094 0.268 0.201 243.42 135.56 81.14 0.7523 0.0091 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.66 81.14 <t< td=""><td>RUN</td><td></td><td></td><td></td><td></td><td></td><td>(LBM/SEC)</td><td></td><td></td><td></td><td>(FT/SEC)</td><td></td></t<>	RUN						(LBM/SEC)				(FT/SEC)	
0.1888 0.2662 0.8789 0.3029 0.1784 0.267 0.050 244.38 95.01 81.45 0.3548 0.1864 0.8789 0.2121 0.3352 0.267 0.095 244.08 106.91 81.35 0.5562 0.1205 0.8789 0.1371 0.4782 0.267 0.135 243.61 117.82 61.26 0.6568 0.0510 0.8789 0.0520 0.6706 0.268 0.176 243.54 128.72 81.18 0.7134 0.0257 0.8789 0.06740 0.268 0.191 243.39 135.84 81.14 0.7509 0.0110 0.8789 0.0163 0.7094 0.268 0.201 243.39 135.56 81.14 0.7523 0.0091 0.8789 0.0103 0.7107 0.268 0.201 243.45 135.66 81.14 ********** 0.0 0.8789 0.0103 0.7107 0.268 0.201 243.45 135.66 81.14		0.0	0.3499	0.8789	0.3981	0.0	0.266	0.0	244.74	81.57	81.57	0.068
0.3548 0.1864 0.8789 0.2121 0.3352 0.267 0.095 244.08 106.91 81.35 0.5062 0.1205 0.8789 0.1371 0.4782 0.267 0.135 243.81 117.82 61.26 0.6568 0.0510 0.8789 0.0580 0.6706 0.268 0.176 243.54 128.72 81.18 0.7134 0.0257 0.0789 0.0770 0.268 0.191 243.48 132.84 81.18 0.7509 0.0140 0.8789 0.0163 0.7094 0.268 0.201 243.49 135.54 81.13 0.7529 0.0110 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.56 81.14 0.7523 0.0091 0.8789 0.0103 0.7107 0.268 0.201 243.45 135.66 81.14 ********** 0.0 0.8789 0.0103 0.7107 0.268 ****** 243.36 ****** 81.12	2	0.1888	0.2662	0.8789	0.3029	0.1784	0.267	0.050	244.38	95.01	81.45	0.068
0.5062 0.1205 0.8789 0.1371 0.4782 0.267 0.135 243.81 117.82 £1.26 0.6568 0.0510 0.8789 0.0580 0.4520 0.268 0.176 243.54 128.72 81.18 0.7134 0.0257 0.8789 0.0770 0.676 0.268 0.191 243.48 132.84 81.18 0.7509 0.0140 0.8789 0.0163 0.7094 0.268 0.201 243.42 135.54 81.13 0.7529 0.0110 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.54 81.14 0.7523 0.0091 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.66 81.14 *********** 0.0 0.8789 0.0 ********** 0.268 ****** 243.42 135.66 81.14	m	0.3548	0.1864	0.8789	0.2121	0.3352	0.267	0.095	244.08	106.91	81.35	0.068
0.6568 0.0510 0.8789 0.0580 0.45206 0.268 0.176 243.54 128.72 81.18 0.7134 0.0257 0.8789 0.0292 0.6740 0.268 0.191 243.48 132.84 81.14 0.7509 0.0144 0.8789 0.0163 0.7094 0.268 0.201 243.39 135.54 81.13 0.7509 0.0110 0.8789 0.0125 0.7095 0.268 0.201 243.42 135.56 81.14 0.7523 0.0091 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.66 81.14 *********** 0.0 0.8789 0.0 ********** 0.268 ******* 243.45 135.66 81.14	4	0.5062		0.8789	0.1371	0.4782	0.267	0.135	243.81	117.82	£1.26	0.068
0.7134 0.0257 0.8789 0.0292 0.6740 0.268 0.191 243.48 132.84 81.14 0.7509 0.0144 0.8789 0.0163 0.7094 0.268 0.201 243.3 135.54 81.13 0.7509 0.0110 0.8789 0.0125 0.7095 0.268 0.201 243.42 135.56 81.14 0.7523 0.0091 0.8789 0.0103 0.7107 0.268 0.201 243.4; 135.66 81.14 ***********************************	S	0.6568	0.0510	0.8789	0.0580	0.6206	0.268	0.176	243.54	128.72	81.18	0.067
0.7509 0.0144 0.8789 0.0163 0.7094 0.268 0.201 243.39 135.54 81.13 0.7509 0.0110 0.8789 0.0125 0.7095 0.268 0.201 243.42 135.56 81.14 0.7523 0.0091 0.8789 0.0103 0.7107 0.268 0.201 243.4; 135.66 81.14 ******** 0.0 0.8789 0.0 ******* 0.268 ****** 243.36 ****** 81.12	9	0.7134	0.0257	0.8789	0.0292	0.6740	0.268	0.191	243.48	132.84	81.16	0.067
0.7509 0.0110 0.8789 0.0125 0.7095 0.268 0.201 243.42 135.56 81.14 0.7523 0.0091 0.8789 0.0103 0.7107 0.268 0.201 243.42 135.66 81.14 ******** 0.0 0.8789 0.0 ******* 0.268 ****** 243.36 ***** 81.12		0.7509	0.0144	0.8789	0.0163	0.7094	0.268	0.201	243,39	135.54	81.13	0.067
0.7523 0.0091 0.8789 0.0103 0.7107 0.268 0.201 243.4; 135.66 81.14	60	0.7509	0.0110	0.8789	0.0125	0.7095	0.268	0.201	243.42	135.56	81.14	0.067
******* 0.0 0.8789 0.0 ******* 0.268 ****** 243.36 ***** 81.12	6	0.7523	0.0091	0.8789	0.0103	0.7107	0.268	0.201	243.43	135.66	81.14	0.067
	10	******	0.0	0.8789	0.0	*****	0.268	*****	243.36	*****	81.12	0.067

0 5.0 6.0 7.0 8.0 0.01 0.01 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.04 0.00 0.00 0.00 0.00 0.00 (e) S/D = 0.0, $M_{H} = 0.068$ HIXING STACK PRESSURE DISTRIBUTION FOR RUN: 13

X/D: 0.0 0.5 3.0 4.0 5.0

IN. H2D1: -1.34 -1.20 -0.21 0.0 0.01

PHS*: -0.10 -0.09 -0.02 0.0 0.00 X/D: PMS(IN. H2D): PMS*:

Table VIII. Continued

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DATA TAKEN 27 HAY 77 BY PETE HARRELL

1/1/9.57/0/05
0.0
STANDOFF
TRANSI TION.
ELLIPTIC
NE NOZZLE.
ž

UPTAKE DIAMETER: 3.00 INCHES	AREA RATIO, AM/AP: 3.00	ORIFICE DIAMETER: 2.154 INCHES	ORIFICE RETA: 0.70	AMBIENT PRESSURE: 29.86 INCHES HG
NUMBER OF PRIMARY NOZZLES: 1	PRIMARY NOZZLE GIAMETER: 1.732 INCHES	MIXING STACK LENGTH; 28.71 INCHES	MIXING STACK DIAMETER: 3.00 INCHES	HIXING STACK L/0: 9.57

												UPT MACH		0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
AREA	CHESI		u ı	-	Ņ	•	-		2	2	•	3	(FT/SEC)	57.93	57.89	57.86	57.83	57.84	57.83	57.82	51.82	57.83	57.73
SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	******	5	(FT/SEC)	57.93	67-45	76.05	83.15	77.06	93.22	15.46	55.57	96.32	*****
PA-PNZ	ER 1	2.37	1.17	1.26	0.77	0.33	0.16	60.0	76.0	90.0	0.0	ď	J	173.80	173.67	173.59	173.50	173.52	173.50	173.46	173.46	173.50	173.19
PA-PS	(INCHES OF WATER)	2.37	1.17	1.26	0.17	0.33	0.16	0.09	10.0	90.0	0.0	HS	Ξ	0.0	0.036	990.0	0.094	0.122	0.131	0.136	0.140	0.142	******
PU-PA	C INC	2.60	3.20	3.60	4.00	4.60	4.70	4-80	4.80	4.80	4.90	3	(LBM/SEC)	0.188	0.188	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189
TAMB	HHEIT)	70.0	70.0	70.0	70.0	0.07	70.0	70.0	70.0	70.0	70.0	55"4*I*M		0.0	0.1784	9856.0	0.4704	0.6108	0.6561	0.6813	1669.0	0.7132	*******
TUPT	(DEGREES FAHREMHEIT)	142.0	145.0	142.0	142.0	143.0	143.0	143.0	143.0	143.0	141.0	P*/T*		1666.0	0.2985	0.2127	0.1301	0.0550	0.0271	0.0147	0.0119	0.0102	0.0
109	Oád)	142.0	142.0	142.0	142.0	143.0	143.0	143.0	143.0	143.0	141.0	ģ.		0.8803	0.9803	0.8803	0.9803	0.8789	0.8789	0.8789	0.8789	0.9789	0.8818
DPOR	OF WATER)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5; G	5.0	5.0	*		0.3513	0.2628	0.1872	0.1145	0.0483	0.0238	0.0129	0.0104	0.0089	0.0
POR	(INCHES (5.6	6.2	9.9	7.0	7.6	7.7	1.7	7.7	7.9	8.0	. 3		0.0	0.1886	0.3581	6164.0	0.6465	9,69.0	0.7211	0.7406	0.7549	*****
z	RUN		7	m	4	S	•	~	80	6	10	z	RUN		2	m	*	'n	9	7	80	6	10

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

	8.0	0.0	0.0	0.048	tinued.
	7.0	0.0	0.0) E	I. Con
	0.9	0.0	0.0	$0 = 0.0, M_{H} = 0.048$	Table VIII. Continued.
?		0 * 0	0.0	(f) S/D =	Tab
	4.0			こ	
	3.0	0.0	0.0		
	9.0	0.0	0.0		
	0.0	0.0	0.0		•
	x/0;	MS(IN. H20):	PMS*:		
•		PMS(IN.			

DATA TAKEN 27 MAY 77 BY PETE HARRELL

1/1/9.57/-024/15 ONE NOZZLE, ELLIPTIC TRANSITION, STANDOFF -0.24

ORIFICE DIAMETER: ORIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIFNT PRESSURE: ORIFICE BETA: 0.70 AMBIFNT PRESSURE: ORIFICE BETA: 0.70 ORIFICE BE		AN NOZZLES:		1 100				UPTAKE DIAMETER:	METER: 3	3.00 INCHES		
ORIFICE DIAMETER: 2.154 INCHES ORIFICE RETA: 0.70 AHBIFNI PRESSURE: 29.06 INCHES HG AHBIFNI PRESSURE: 29.06 INCHES! O.700 O.00 O	PRIMARY NOZZLE DIAMETER: 1.732 INCHES		L-732 INCHES	FS				AREA RATIT), AM/AP:	3.00		
PU-PA PA-PS PA-PNZ SECONDARY AREA	MIXING STACK LENGTH; 28.71 INCHES	NGTH: 28.71 INCHES	1 INCHES					ORIFICE DI		2.154 INCHES		
Holpa PA-PS PA-PN2 SECONDARY AREA (INCHES OF WATER) S.35 O.785	MIXING STACK DIAPETER: 3.00 INCHES		.00 INCHES					ORIFICE RE				
PU-PA PA-PS PA-PN2 SECONDARY AREA INCHESI IN	MIXING STACK L/D: 9.57 .	6						AMBIENT PR		29.86 INCHES	HG	
0 7.60 7.00 0.00 0.00 0.00 0.00 0.00 0.0	POR DPOK TOR TUFT	TOR		TUFT		TAMB	PU-PA	PA-PS	PA-PNZ	SECONDARY	AREA	
7.60 7.00 7.00 0.00 9.30 5.35 5.35 0.785 10.70 3.80 3.80 1.747 12.00 2.46 2.46 3.142 13.30 1.03 1.03 6.284 13.80 0.51 0.51 9.621 14.00 0.18 0.22 15.812 14.00 0.18 0.18 17.082 14.20 0.0 0.0 0.0 99.97 0.325 0.0 299.92 99.97 99.97 0.326 0.062 297.29 116.37 99.76 0.326 0.062 297.29 116.37 99.96 0.328 0.217 296.04 130.96 96.98 0.328 0.244 296.91 162.23 98.96 0.328 0.247 296.81 165.86 96.93 0.328 0.247 296.81 165.68 96.93 0.328 0.247 296.81 165.68 96.93	(INCHES OF WATER) (DEGREES FAHRENHEIT)	8	(DEGREES FAHRENH	REES FAHRENH	E	EIT)	20	CHES OF WA	ITER)	(SQUARE IN	CHE S.)	
9.30 5.35 5.35 0.785 10.70 3.80 1.7¢7 12.00 2.46 2.46 3.142 13.30 1.03 1.03 6.28¢ 13.30 0.51 0.51 9.621 13.80 0.22 0.22 18.512 14.00 0.18 0.18 17.082 14.20 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	16.6 15.0 149.0 149.0	149.0		140.0		0.63	7.60	7.00	7.00	0.0		
10.70 3.80 3.80 1.7¢7 12.00 2.46 2.46 3.142 13.30 1.03 1.03 6.284 13.80 0.51 0.51 9.621 14.00 0.22 0.22 15.912 14.00 0.18 0.18 17.082 14.20 0.0 0.0 99.97 99.97 0.325 0.0 299.92 99.97 99.97 0.326 0.062 299.92 99.97 99.97 0.328 0.217 297.09 157.73 99.96 0.328 0.217 297.09 157.73 99.96 0.328 0.244 296.91 16.25 98.96 0.328 0.247 296.81 165.89 98.98 0.328 0.247 296.81 165.89 98.98 0.328 0.247 296.81 165.68 98.93 0.328 0.247 296.81 165.68 98.93	18.3 15.0 149.0 149.0	149.0		149.0		0.69	9.30	5.35	5.35	0.78	ın	
12.00 2.46 2.46 3.142 13.30 1.03 1.03 6.284 13.30 0.51 0.51 9.621 13.90 0.28 0.20 15.512 14.00 0.18 0.18 17.082 14.20 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	19.7 15.0 146.0 146.0	146.0		146.0		0.69	10.70	3.80	3.80	1.76	~	
13.30 1.03 1.03 6.284 13.80 0.51 0.51 9.621 13.90 0.28 0.28 13.548 14.00 0.18 0.18 13.548 14.00 0.18 0.18 17.082 14.20 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	21.0 15.0 146.0 146.0	146.0		146.0		0.63	12.00	2.46	2.46	3.14	~	
13.80 0.51 9.621 13.90 0.28 0.21 13.548 14.00 0.12 0.22 15.512 14.00 0.18 0.18 17.082 14.20 0.18 0.18 17.082 14.20 0.0 0.0 0.0 14.20 0.0 0.0 0.0 0.32 0.0 299.92 99.97 99.97 0.326 0.062 299.92 99.97 99.97 0.326 0.062 299.92 99.97 99.97 0.328 0.017 298.04 130.96 96.34 0.328 0.117 298.04 137.73 99.96 0.328 0.217 296.91 162.23 98.96 0.328 0.244 296.91 165.23 98.96 0.328 0.244 296.91 165.68 96.93 0.328 0.247 296.81 165.98 96.93 0.328 0.247 296.81 <t< td=""><td>22.3 15.0 146.0 146.0</td><td>146.0</td><td></td><td>146.0</td><td></td><td>0.69</td><td>13.30</td><td>1.03</td><td>1.03</td><td>6.28</td><td>.</td><td></td></t<>	22.3 15.0 146.0 146.0	146.0		146.0		0.69	13.30	1.03	1.03	6.28	.	
13.90 0.28 0.28 13.548 14.00 0.22 0.22 15.812 14.00 0.18 17.002 14.20 0.0 0.18 17.002 14.20 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	22.8 15.0 146.0 146.0	146.0		146.0		0.69	13.80	0.51	0.51	9.45	-	
14.00 0.22 0.22 15:512 14.00 0.18 17.002 14.20 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	22.9 15.0 146.0 146.0	146.0		146.0		0.69	13.90	0.28	0.28	13.54	•	
14.20 0.18 0.18 17.082 14.20 0.0 0.0 ****************************	22.9 15.0 146.0 146.0	146.0 146.0	146.0			0.69	14.00	0.22	0.22	15.51	~	
14.20 0.0 0.0 ****************************	22.9 15.0 146.0 146.0	146.0 146.0	146.0		•	0.69	14.00	0.18	0.18	17.00	~	
(LBM/SEC) (LBM/SEC) (FT/SEC) (23.2 15.0 146.0 146.0	146.0 146.0	146.0		_	69.0	14.20	0.0	0.0	••••••	•	
(LBM/SEC) (LBM/SEC) (FT/SEC) (FT/SEC) 0.325 0.0 299.92 99.97 99.97 0.326 0.062 299.29 116.37 99.76 0.327 0.117 296.04 130.96 99.34 0.328 0.217 297.56 144.45 99.18 0.328 0.234 296.91 162.23 99.96 0.328 0.244 296.81 165.23 99.95 0.328 0.247 296.81 165.68 99.93 0.328 0.247 296.81 165.68 99.93	We pe Te pa/te We	47, pa/1a	p./T.		3	75.4+1+M	A P	MS	a a	3	3	UPT MACH
0.325 0.0 299.92 99.97 99.97 0.326 0.062 299.29 116.37 99.97 0.326 0.062 299.29 116.37 99.97 0.328 0.328 0.217 298.04 133.96 99.34 0.328 0.217 294.09 157.73 99.96 0.328 0.244 296.91 162.23 99.96 0.328 0.244 296.81 164.98 99.93 0.328 0.247 296.81 165.68 99.93 0.328 0.328 296.81 165.68 99.92							(LBM/SEC				(FT/SEC)	
0.326 0.062 299.29 116.37 99.76 0.327 0.117 298.04 133.96 99.34 0.328 0.168 297.56 144.45 99.18 0.328 0.217 297.09 157.73 99.03 0.328 0.244 296.01 162.23 98.96 0.328 0.244 296.01 165.23 98.99 0.328 0.247 296.01 165.94 50.93 0.328 296.07 296.01 165.99 98.92	0.8686 0.4005	0.8686 0.4005	0.4005			0.0	0.325	0.0	299.92	16.66	16.98	0.083
0.327 0.117 298.04 130.96 95.34 0.328 0.166 297.56 144.45 99.18 0.328 0.217 297.09 157.73 99.03 0.328 0.234 296.91 162.23 98.96 0.328 0.244 296.81 165.94 58.93 0.328 0.247 296.81 165.68 98.93	0.8686 0.3073	0.8686 0.3073	0.3073		Ĭ	0.1785	0.326	0.062	299.29	116.37	99.76	0.082
0.328 0.217 297.09 157.73 99.03 0.328 0.234 296.91 162.23 98.96 0.328 0.244 296.91 162.23 98.96 0.328 0.244 296.81 164.98 98.93 0.328 0.247 296.81 165.68 98.93 0.328 ************************************	0.3587 0.1912 0.8729 0.2191 0	2 0.8729 0.2191	0.2191		•	0.3379	0.327	0.117	298.04	130.96	95.34	0.082
0.328 0.217 297.09 157.73 99.03 0.328 0.234 296.91 162.23 98.96 0.328 0.244 296.81 164.98 98.93 0.328 0.247 296.81 165.68 98.93 0.328 ************************************	0.5125 0.1242 0.8729 0.1423 0.	0.8729 0.1423	0.1423		ċ	0.4827	0.328	0.168	297.56	144.44	96.10	0.082
0.328 0.244 296.81 165.23 98.96 0.328 0.244 296.81 165.94 58.93 0.328 0.247 296.81 165.68 98.93 0.328 ************************************	0.6622 0.0522 0.8729 0.0598 0.	0.8729 0.0598	0.0598		ċ	6237	0.328	0.217	297.09	157.73	99.03	0.082
0.328 0.244 296.88 164.98 98.93 0.328 0.247 296.81 165.68 98.93 0.328 ************************************	0.7130 0.0259 0.8729 0.0296 0.	0.8729 0.0296	0.0296		ò	9119	0.328	0.234	296.91	162.23	98.96	0.082
0.328 0.247 296.81 165.68 98.93 0.328 ************************************	0.7438 0.0142 0.8729 0.0163 0.	0.8729 0.0163	0.0163		ċ	9002	0.328	0.244	296.88	164.98	98.95	0.082
0.328 0.247 296.81 165.68 98.93 0.328 ****** 296.77 ***** 98.92	0.8729 0.0128	0.8729 0.0128	9.0128		Ó	0.7111	0.328	0.248	296.81	165.94	58.53	0.082
0.328 ***** 296.77 ***** 98.52	0.8729 0.0105	0.8729 0.0105	0.0105		ó	0.7083	0.328	0.247	296.81	165.68	10.93	0.082
	**** 0.0 0.8729 0.0 ****	0.8729 0.0	0.0		***	*******	0.328	• • • • • •	296.77	*****	98.52	20.0

(g) S/D = -0.24, $M_{ll} = 0.082$ HIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10 0.0 3.0 0.0 0.00 X/0: PMS(IN. H2O): PMS*:

0 0 0

Table VIII. Continued.

DATA TAKEN 27 HAY 77 BY PETE HARRELL

	9	AREA CHES)		5 1	~	2	•	-	¥.	~	TV.	•	3	(FT/SEC)	61.29	01.10	10.10	.1.08	00.79	80.08	15.08	96.00	16.00	91.35
	3.00 INCHES 3.00 2.154 INCHES 0	SECONDARY AREA ISCUARE INCHES)	0.0	0.785	1 767	3.142	4.284	9.621	12.54	15.512	17.082	•••••	ž	(FT/SEC)	61.29	94.76	106.89	118.12	120.97	137.08	135.42	136.35	137.75	•
	~ 2	PA-PII? WATERI	4.64	3.55	2.52	1.64	0.48	0.40	61.0	0.15	0.13	0.0	Š	() (FT/SEC)	243.90	243.56	243.30	243.26	242.38	242.96	242.93	242.90	242.90	244.05
	UPTAKE UIAMETER: AREA RATIO, AN/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.7/	PA PA-PS	4.64	3,55	2.52	1.64	0.68	0.40	0.19	0.15	0.13	0.0	S Z	(LBM/SEC)	0.0	0.030	0.095	0.137	0.176	0.201	0.201	0.205	0.210	*****
-01/520-	7 4 0 5 4	PU-PA	5.10	6.20	7.10	7.90	8.80	9.00	6.13	9.20	9.20	05.6	3	(LBM/SEC)	13.267	0.248	0.268	0.268	0.269	0.248	0.268	0.268	0.268	19:00
1/1/9.57/-024/10		TAMB NHE IT)	70.0	10.0	70.0	0.65	70.0	20.0	70.0	70.0	10.0	70.0	##T**.44		0.0	0.1783	0.3378	0.4841	0.6226	0.7311	0.7094	0.7216	0.7398	
-0.24	S	TUPT TAM	139.0	139.0	139.0	140.0	137.0	140.0	140.0	140.0	140.0	146.0	+L/+d		0.3948	0.3029	0.2155	0.1405	0.0584	9463.0	3.0163	0.0129	0.0112	0.0
STANDOFF	55: 1 : 1.732 INCH :71 INCHES 3.00 INCHES	TOR (DEG	139.0	139.0	139.0	146.0	137.0	140.0	140.0	140.0	140.0	146.0	*		0.8847	0.8847	0.8847	0.8833	0.8877	0.8833	0.8833	0.8833	0.8833	0.8745
IC TRANSITION, STANDOFF	RIHARY NDZZLES: I 2LE DIAMETER: 1.732 INCHES K LENGTH: 28.71 INCHES K DIAMETER: 3.00 INCHES K L/D: 9.57	UPUR Of Water)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	*		0.3493	0.2680	0.1906	0.1241	0.0518	0.0303	0.0144	0.0114	0.3099	0.0
ELLIPTIC T	NUMBER UF PRIMARY NUZZLES: I PRIMARY NGZZLE DIAMETER: 1.732 IN MIXING STACK LENGTH: 28.71 INCHES MIXING STACK DIAMETER: 3.00 INCH MIXING STACK L/D: 9.57	POR (INCHES		12.2	13.1	13.9	14.8	15.1	15.2	15.3	15.3	15.5	*		0.0	0.1882	0.3565	0.5113	0.6561	0.7721	0.7493	0.7621	0.7813	*****
ONE NOZZLE, ELLIPT	NOMB PRIM MIXII MIXII	z z	~	2	ĸ	4	s	•	~	60	o	10	z	RUN	-	7	e	4	ห	٥	_	œ	σ	10

UPT MACH

HIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

X/D: 0.0 0.5 3.0 4.0 5.0 6.0 7.0 8.0

PHSIIN. H201: -1.46 -1.30 -0.37 -0.12 -0.07 -0.04 0.00 0.00

PHS: -0.11 -0.10 -0.03 -0.01 -0.00 -0.00 0.00

(h) S/D = -0.24, M_u = 0.068

Table VIII. Continued.

DATA TAKEN 27 MAY 77 BY PETE HARRELL

	9	AREA	ICHES)		. 51	~	~	<u>*</u>	-	•	~	ç	•	3	(FT/SEC)	57.59	57.56	57.52	57.49	57.46	57.44	57.49	57.49	57.54	57.87
	3.00 INCHES 3.00 2.154 INCHES 0 25.86 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	5.621	13.546	15.512	17.062	••••••	ž	(FT/SEC)	57.59	67.25	15.87	83.26	90.38	55.95	94.40	94.85	94.53	*****
	m _ 2	PA-PN2	ATERI	2.34	1.80	1.27	62.0	0.32	0.16	0.00	0.07	0.05	0.0	å	(FT/SEC)	172.79	172.68	172.58	172.49	172.39	172.34	172.49	172.49	172.63	173.62
	UPTAKE DIAMETER: AREA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.7	PA-PS	(INCHES OF WATER)	2.34	1.80	1.27	0.79	.0.32	91.0	0.09	0.07	0.05	0.0	#S	(LBM/SEC)	0.0	0.036	0.068	0.095	0.121	0.131	0.136	0.137	0.136	*****
-024/05		PU-PA	3 T	5.60	3.10	3.60	4.00	4.50	4.70	4.70	4.70	4.70	4.80	Š	(LBM/SEC)	0.189	0.100	0.190	0.190	0.190	0.190	051.0	0.190	0.190	0.189
1/1/9.57/-024/05		TAMB	ENHEIT)	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	NeT **. 44		0.0	0.1797	0.3396	0.4760	0.6074	0.6554	0.6806	0.6890	0.6824	******
-0.24	ES	TUPT	(DEGREES FAHRENHEIT)	135.0	135.0	135.0	135.0	135.0	135.0	136.0	136.0	137.0	144.0	P*/T*		0.3940	0.3035	0.2144	0.1335	0.0545	9.0271	0.0147	0.0115	0.0093	0.0
STANDOFF	S: 1 1.732 INCH 71 INCHES 3.00 INCHES	T0R	1066	135.0	135.0	135.0	135.0	135.0	135.0	136.0	136.0	137.0	144.0	:		0.8941	0.8941	0.8941	0.8941	0.8941	0.8941	9268.0	9268.0	0.8911	£ 8807
IC TRANSITION, STANDOFF	RIMARY NDZZLES: 1 ZLE DIAMETER: 1.732 INCHES K LENGTH: 28.71 INCHES K DIAMETER: 3.00 INCHES K L/D: 9.57	DPOR	OF WATER!	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	. 5.0	*		0.3523	0.2713	0.1917	0.1193	0.0487	0.0242	0.0131	0.0103	0.0083	0.0
. ELLIPTIC T	NUMBER OF PRIMARY NOZZLES: 1 PRIMARY NOZZLE DIAMETER: 1.732 IN MIXING STACK LENGTH: 28.71 INCHES MIXING STACK DIAMETER: 3.00 INCH	POR	(INCHES	5.6	6.1	9.9	7.0	7.5	7.7	7.7	7.7	7.7	7.8	*		0.0	0.1888	0.3567	0.5001	1869.0	0.6885	0.7155	0.7243	0.7179	****
ONE NOZZLE, ELLIPT	NUN PRI HIX	z	RUN	-	7	m	4	ĸ	9	1	89	σ	10	z	RUN	-	8	m	4	ហ	9	~	80	6	10

HIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

X/D: 0.0 0.5 3.0 4.0 5.0 (.0

PMS(IN. H20): 0.0 0.0 0.0 0.0 0.0

PMS*: 0.0 0.0 0.0 0.0 0.0 0.0

(i) S/D = -0.24, $M_u = 0.048$ Table VIII. Continued.

DATA TAKEN 27 MAY 77 BY PETE HARRELL

1/1/9.57/-084/15
-0-84
STANDOFF
TRANSITION,
ELL IPTIC
NO ZZLE.
ONE

NUMBER	OF PRIMAR	NUMBER OF PRIMARY NOZZLES:	***			בֿל בּ	UPTAKE DIAMETER:		3.00 INCHES		
PRIMAR	N NOZZLE D	PRIMARY NOZZLE DIAMETER: 1.732 INCHES	-732 INCHE	S		A	AREA RATIO, AM/AP:		3.00		
MIXING	STACK LEN	MIXING STACK LENGTH: 28.71 INCHES	INCHES			ä	ORIFICE DIAMETER:		2.154 INCHES		
MIXING	MIXING STACK DIAMET	ER:	3.00 IMCHES			Ö	ORIFICE BETA:	A: 0.70			
MIXING	MIXING STACK L/D:	15.6 :0				¥	AMBIENT PRESSURE:		29.86 INCHES HG	HG	
z	POR	DPOR	TOR	TUPT	TAHB	PU-PA	PA-PS	PA-PNZ	SECONDARY AREA	REA	
RUN	(INCHES O	OF WATER!	(DEGP	(DEGPEES FANREMIETT)	MHEIT)	CINCH	INCHES OF WATER!	ER)	(SQUARE INCHES)	HES)	
	16.7	15.0	146.0	146.0	71.0	7.70	6.90	9.90	0.0		
7	13.1	15.0	146.0	146.0	71.0	01.6	5.30	5.30	0.785		
m	19.2	15.0	146.0	146.0	71.0	10.30	3.66	3.66	1.767		
4	20.1	15.0	146.0	146.0	71.0	11.10	22.22	2.22	3.142		
w	20.9	15.0	146.0	146.0	71.0	11.80	0.85	0.85	6.284		
•	21.0	15.0	146.0	146.0	71.0	12.00	0.41	0.41	9.621		
7	21.1	15.0	145.0	145.0	71.0	12.10	0.22	0.22	13.548		
80	21.2	15.0	145.0	145.0	71.0	12.10	0.17	71.0	15.512		
٥	21.2	15.0	145.0	145.0	71.0	12.10	0.14	0.14	17.082		
, ot	21.3	15.0	147.0	147.0	71.0	12.20	0.0	0.0	****		
z	*	å	*	P*/T*	74.4T*W	d X	Š	an B	ž	n	UPT MAC
PUN						(LBM/SEC)	(LBM/SEC)	(FT/SEC)	(FT/SEC)	(FT/SEC)	
	0.0	0.3459	0.8762	0.3948	0.0	0.326	0.0	299.14	99.71	99.71	5.083
2	0.1882	0.2666	0.8762	0.3043	0.1776	0.327	190.0	298.62	116.13	99.54	0.083
æ	0.3516	0.1847	0.8762	3.2108	0.3317	0.327	0.115	298.15	130.48	86.38	0.082
4	0.4864	0.1122	0.8762	0.1281	0.4589	0.327	0.159	297.89	145.42	62.66	0.082
, v	0.6014	0.0430	0.8762	0.0491	9.5674	0.328	0.197	297.67	152.43	99.22	0.082
9	0.6394	0.0208	0.8762	0.0237	0.6033	0.328	0.210	297.56	156.00	55.18	0.082
7	0.6589	0.0112	9.8776	0.0127	0.6222	0.328	0.216	297.28	157.71	60°55	0.082
8	0.6631	0.0086	0.8776	9600°C	0.6261	0.328	0.218	26.162	158.10	99.10	0.082
0	0.6627	0.0071	0.8776	0.0081	0.6257	0.328	0.217	297.32	158.07	99.10	0.082
10	******	0.0	0.8747	0.0	*****	0.327	*****	297.17	****	95.25	0.082

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

	, 0.4	0.0	0.0	(j) $S/D = -0.84$, $M_u = 0.082$	Table VIII. Continued.
	7.0	60.0-	-0.00	84, M	II. Cor
	0.9	-1.06 -0.55 -0.36 -0.25	10.0-	-0-	ble VI
·	5.0	-0-36	-0.02	(j) S/D	Ta
יייי אייי	4.0	-0.55	-0.03	Ŏ	
001 1001 V	3.0	-1.06	-0.05		
TO DANG	0.5	-2.15	-0.11		
1CP TAES.	0.0	-2.51	PMS*: -0.13		
MINING SIACH PRESSONE UISINISOLION FOR ACON. TO	:0/X	PMS(IN. H20):	PMS*:		

DATA TAKEN 27 MAY 77 BY PETE HARRELL

1/1/9.57/-084/10
-0-84
STANDOFF
TRANSITION,
ELLIPTIC 1
NOZZEE.
Š

																	UPT MACH		0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068
				не	IREA	CHESI		us	•	534	.=		~				3	(FT/SFC)	81.72	£1.68	81.61	81.55	18.18	81.56	81.36	81.41	81.41	61.66
3.00 INCHES	3.00	2.154 INCHES		29.86 INCHES HG	SECONDARY AREA	(SOUARE INCHES!	0.0	6.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	******	ň	(FT/SEC)	81.72	95.20	106.77	116.78	125.02	128.38	129.65	130.86	131.12	*****
			IA: 0.70	SSURE: 2	PA-PNZ	ER)	4-54	3.54	2.41	1.49	0.57	0.28	0.15	0.12	0.10	0.0	ď	(FT/SEC)	245.17	245.05	244-83	244.65	244.13	244.70	244.10	244.24	244.24	244.99
UPTAKE DIAMETER:	AREA RATIO, AM/AP:	ORIFICE DIAMETER:	ORIFICE BETA: 0.70	AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	4.54	3.54	2.41	1.49	0.57	0.28	0.15	0.12	0.10	0-0	S#	(LBM/SEC) (FT/SEC)	0.0	0.050	0.093	0.131	0.161	0.173	9-179	0.183	0.184	*****
•	∢	0	0	◀	PU-PA	CINC	2.00	00.9	6.70	7.30	7.80	7.90	7.90	8.00	8.00	8.20	d.	(LBM/SEC)	0.266	0.266	0.266	0.266	0.267	0.266	0.267	0.267	0.267	0.266
					TAMB	NHEIT)	70.0	70-0	70.0	70.0	70.0	70.0	0.07	70.0	70.0	70.07	H*T**.44		0.0	0.1782	0.3307	0.4621	0.5711	0.6129	0.6315	0.6468	0.6502	*****
	ES				TUPT	(DEGPEES FAHRENHEIT)	145.0	146.0	146.0	146.0	144.0	147.0	144.3	145.0	145.C	149.0	P*/T*		1986.0	0.3019	0.2059	0.1275	0.0488	0.0240	7.0128	0.0103	9800*0	0.0
	1.732 INCH	28.71 INCHES	3.00 INCHES		TOR	950)	145.0	146.0	146.0	146.0	144.0	147.0	144.0	145.0	145.0	140.0	<u>.</u>	,	0.8760	0.8745	0.8745	0.8745	0.8774	0.8731	0.8774	0.8760	0.8760	0.8702
RY NOZZLES	DIAMETER:		Ek:	15.6 :0	OPOR	OF WATER!	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	*d		0.3382	0.2640	0.1800	0.1115	0.0428	0.0209	0.0113	0.0000	0.0075	0.0
NUMBER OF PRIMARY NOZZLES:	PRIMARY NOZZLE DIAMETER: 1.732 INCHES	MIXING STACK LENGTH:	MIXING STACK DIAMET	MIXING STACK L/D:	POR	(INCHES (11.1	12.0	12.7	13.3	13.9	14.0	14.0	14.0	14.0	14.2	*3		0.0	0.1890	0.3508	0.4901	6,09.0	0.6506	0.6689	0.6856	0.6892	*****
NUMB	PRIM	HIXI	HXIX	HIXI	z	RUN	7	7	æ	4	ď	9	1	80	6	10	z	RUN	-	7	m	4	S	9	~	80	ۍ	10

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

9.0	0.0	0.0	0.068
7.0	-0.03	-0.00	-0.84, M _u =
6.9	-0.12	-0.01	= -0.8
	-0.19		(k) S/D
4.0	-0.31	-0.02	=
3.0	-0.61	-0.05	
0.5	-1.40	-0.10	
0.0	-1.65	-0.12	
x/0:	. H201:	PMS*:	
	PHS (IN.		

Table VIII. Continued.

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DATA TAKEN 26 MAY 77 BY PETE HARRELL

1/1/9.57/-084/05
-0.84
STANDOFF
TRANSITION.
ELLIPTIC
ONE NOZZLE.

													UPT MACH		0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
9	IPEA	HES)							_				3	(FT/SEC)	56.17	58.12	58.09	56.08	58.06	58.06	58.06	58.06	56.06	58.04
3.00 INCHES 3.00 2.154 INCHES 0 25.78 INCHES HG	SECONDARY AREA	(SOUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	***	Š	(FT/SEC)	58.17	67.62	75.82	82.38	A7.88	89.79	90.39	90.06	90.72	****
ETER: 3. Am/ap: Meter: 2 A: 0.70 Ssure: 2	PA-PNZ	ER)	2.27	1.74	1.19	0.71	0.27	0.13	0.07	90.0	0.04	0.0	å	(FT/SFC)	174.51	174.36	174.29	174.25	174.21	174.18	174.18	174.18	174.18	174.14
UPTAKE DIAMETER: 3 AREA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	2.27	1.74	1.19	11.0	0.27	6.13	0.01	0.05	0.04	0.0	MS	(LBM/SEC)	0.0	0.035	0.065	0.000	0.110	0.117	0.119	0.118	0.120	*****
7 4 9 9 4	₽u-nd	CINCH	2.50	3.10	3.40	3.70	3.90	4.00	4.00	4.00	4.00	4.10	3	(LBM/SEC)	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188
	TAMB	NHE IT 9	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	44.44 T*H		0.0	0.1769	1626.0	0.4502	0.5519	0.5872	0.5983	0.5917	0.6043	******
ĘS	TUPT	(DEGREES FAHRENHEIT)	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	*1/*0		3.3821	0.2934	0.2008	0.1190	0.3448	0.0216	0.0113	0.0084	0.3073	0.0
S: 1 1.732 INCH 71 INCHES 3.00 INCHFS	TOR	(neg	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	*		0.8793	0.8793	0.8793	0.8793	0.8793	0.8793	0.8793	0.8793	0.8793	0.8793
LE R: 8.	DPOR	INCHES OF WATER!	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	*d		0.3359	0.2579	0.1765	0.1046	0.0394	0.0390	0.0100	4100.0	0.0064	0.0
NUMBER OF PRIMARY MOZZ PRIMARY NOZZLE DIAMETE MIXING STACK LENGTH: 2 MIXING STACK DIAMETER: HIXING STACK L/D: 9-	POR	(INCHES	5.6	6.1	4.9	6.8	7.0	7.1	7.1	7.1	7.1	7.1	ż		0.0	0.1872	0.3483	0.4765	0.5841	0.6214	0.6331	0.6262	0.6395	******
NUMBE PRIMA HIXIN MIXIN	z	RUN		8	e	4	ĸ	ø	1	60	6	10	z	RUN	-	7	m	4	Ŋ	9	1	80	6	10

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

PHSIIN. H201: -0.80 -0.68 -0.29 -0.14 -0.08 -0.04 0.03 0.00 PHSIIN. H201: -0.80 -0.10 -0.04 -0.02 -0.01 0.00 0.00 0.00 0.00 PHS*: -0.12 -0.10 -0.04 -0.02 -0.01 0.01 0.00 0.00 (1) S/D = -0.84, M = 0.048

Table VIII. Continued.

DATA TAKEN 31 HAY BY PETE HARRELL

4 × 4 >

1/1/7.57/100/15
1.00
STANDOFF
TRANSITION.
ELLIPTIC
ONE NOZZLE.
ONE

			-		~	-					•	UPT MACH		0.083	0.083	₹80° 0 ·	0.082	0.082	\$80.0	0.082	280.0	0.082	0.082
Н6	AREA (CHES)		y 1	1.	į,	51	.		2	75	•	n n	(FT/SEC)	100.51	100.26	100.04	95.91	99.74	99.57	55.55	99.28	99.28	90*55
3.00 INCHES 3.00 2.154 INCHFS 0 29.84 INCHES HG	SECONDAPY AREA (SCUARE INCHES)	0.0	0.765	1.767	3.142	6.284	9.621	13.548	. 15.512	17.082	******	¥	(FT/SEC)	100.51	116.62	130.83	142.87	155.25	159.04	160.72	161.64	162.30	* * * *
UPTAKE DIAMETER: 3.0 AREA RATIO, AH/AP: 3 ORIFICE DIAMETER: 2. ORIFICE BETA: 0.70 AMBIENT PRESSURE: 29	PA-PNZ ER)	7.10	5.18	3.60	2.21	0.92	0.45	0.24	0.19	0.16	0.0	dn	(LBM/SEC) (FT/SEC)	301.54	300.80	300.14	299.74	299.22	298.73	298.66	297.86	297.86	297.19
	PA-PS PA (INCHES OF WATER)	7.10	5.18	3.60	2.21	0.92	0.45	0.24	0.19	0.16	0-0	Ą		0.0	190.0	0.114	0.159	0.205	0.219	0.226	0.230	0.232	*****
5 4 5 5 4	PU-PA	7.50	9.40	11.20	12.40	13.80	14.20	14.40	14.50	14.50	14.60	3	(LBM/SEC)	0.323	0.324	0.325	0.525	0.326	0.326	0.326	0.326	0.326	0.328
	TAMB.	71.0	71.0	71.0	11.0	71.0	71.0	71.0	71.0	71.0	71.0	W*T**-44		0.0	0.1757	0.3290	0.4576	0.5895	0.6317	9.6495	0.6614	0.6684	******
S	TUPT TAM (DEGREES FAHRENHEIT)	155.0	155.0	155.0	155.0	155.0	155.0	155.0	152.0	152.0	148.0	*1/*d		1905.0	0.2977	0.2078	0.1279	0.0534	0.0262	0.0140	0.0111	0.0093	0.0
ES: 1 1.732 INCH 7.1 INCHES 3.00 INCHES	TOR	155.0	155.0	155.0	155.0	155.0	155.0	155.0	152.0	152.0	148.0	*		0.8633	0.8633	0.8633	0.8633	66. 0	0 در	0., 13	9.8676	0.8676	0.8733
RY NOZZLES DIAMETER: NGTH: 22-7 AMETER: 3	DPOR	. 15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	å		0.3506	0.2570	0.1794	0.1104	0.0461	0.0226	0.0121	9600.0	0.0081	0.0
NUMBER OF PRIMARY NOZZLES: 1 PRIMARY WJZLE OIAMETER: 1,732 INCHES MIXING STACK LENGTH: 22.71 INCHES MIXING STACK DIAMETER: 3.00 INCHES MIXING STACK L/O: 7.57	POR DPOR	16.5	18.3	20.1	21.4	22.8	22.2	22.4	22.4	22.4	23.5	*		0.0	0.1874	0.3509	0.4882	0.6289	0.6739	0.6928	0.7041	0.7115	*****
NUMBEL PRIMAE MIXIN MIXIN	z 2		8	m	4	'n	•	1	9	6	10	z	RUN	7	2	ю	4	'n	9		80	6	10

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

6.0			
5.5			
5.0	0.0	0.0	
4.5	0.0	0.0	
4.0 4.5 5.0	0.0	0.0	
3.5	0.0	0.0	
3.0	0.0	0.0	
2.5	0.0	0.0	
0.5	0.0	0.0	
0.0	0.0	0.0	
x/0: 0.0 0.5 2.5 3.0	PHS (IN. H20):	PMS+:	

(a) S/D = 1.0, $M_u = 0.082$

Table IX. Single-Nozzle Performance Data for L/D = 7.57, Elliptic Transition.

DATA TAKEN 31 MAY BY PETE HARRELL

	•									*		•	UPT PACH		890.0	0.068	0.06e	0.068	0.067	0.067	190.0	190.0	0.067	0.067
	H G	AREA CHES)		5 0	2	~	4	-	60	8	2	•	n	(FT/SEC)	82.02	81.88	81.84	e1.82	61.80	81.83	81.88	81.89	£1.65	81.41
	3.00 INCHES 2.00 2.154 INCHES 0 29.84 INCHES HG	SECONDARY AREA (SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.062	*****	5	(FT/SEC)	82.02	95.18	106.78	117.03	126-91	130.67	132.47	133,30	131.38	* * * * *
ONE NJ22LE. ELLIPTIC TRANSITION. STANDOFF 1.00 1/1/7.57/100/10	m 0	PA-PNZ ER1	4.70	3.43	2.37	1.49	0.61	0.31	0.17	0.13	0.10	0.0	ПР	(FT/SEC)	246.08	245.66	245.52	245.48	245.42	245.50	245.67	245.70	245.09	244.23
	AREA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.7	PA-PS PA (INCHES OF WATER)	4.70	3.43	2.37	1.49	0.61	0.31	0.17	0.13	01.0	0.0	#S	(LBM/SEC)	0.0	0.049	0.093	0.131	0.167	0.181	0.187	0.190	0.184	****
	U AR O O A	PU-PA (INC)	2.00	6.30	7.40	8.25	9.10	9.50	09.6	09.6	09.6	9.70	Я	(LBM/SEC)	0.265	0.265	0.265	0.265	0.266	0.265	0.265	0.265	0.266	0.267
		TAMB NHEIT)	70.0	. 70.0	70.0	70.0	70.0	0.07	70.0	10.07	70.07	70.0	55°**1+N		0.0	0.1754	0.3278	0.4617	0.5904	0.6389	0.6617	0.6724	0.6492	****
	S.	TUPT TAM (DEGREES FAHRENHEIT)	149.0	148.0	150.0	151.0	152.0	153.0	154.0	154.0	151.0	147.0	*1/*d		1665.0	0.2927	0.2028	0.1277	0.0524	0.0262	0.0142	0.0112	0.0386	0.0
	S: 1 1.732 INCHE 71 INCHES 3.00 INCHES	TOR (0EGF	149.0	149.0	150.0	151.0	152.0	153.0	154.0	154.0	151.0	147.0	*		0.8702	0.8702	0.8688	0.8674	0.8659	0.8645	0.8631	0.8631	0.8674	0.8731
	LE R: 2.	DPOR OF WATER)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	å	•	0.3478	0.2547	0.1762	0.1108	0.0454	0.0227	0.0123	1600.0	0.0075	0-0
	NUMBER OF PRIMARY NOZZ PRIMARY NOZZLE DIAMETE MIXING STACK LENGTH: 2 MIXING STACK DIAMETER: MIXING STACK L/O: 7-	POR DPOR	11.1	12.3	13.4	14.3	15.1	15.5	15.6	15.7	15.7	15.7	3	ŧ	0-0	0.1865	0.3487	0.4916	0.6290	0.6811	0.7060	97174	0.6912	***
ONE NO ZZLE.	NUMBE PRIM MIXIN MIXIN	2 3		. 2	· m	4	I O	. •0		. 00	• •	10	2			• 2	ı m	4	r vo	. •0		· cc	•	10

0.00

5.5

0.10

0.07 4.5

0.09 4.0

3.5

3.0 0.07 0.00

2.5 0.01 0.00

0.5

0.0 -0.06

X/D: PMS (IN. H2O): PMS*:

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

2.0

(b) S/D = 1.0, $M_u = 0.068$

Table IX. Continued.

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AUTOER OF PRIM		,							
PRIMARY NOZZLE HIXING STACK LI	IMARY NOZZLES: 1 LE CIAMETER: 1.732 INCHES IFNGTH: 22_21 INCHES	5: 1 1.732 INC: 7: INC::ec	HES			UPTAKE DIAMETER: AREA RATIO, AM/AP:	**	3.00 INCHES 3.00	
	OLANETER: 3	3.00 INCHES	v			ORIFICE DIAMETER: ORIFICE BETA: 0.70	AMETER: TA: 0.7(2.154 INCHES	60
MIXING STACK L	1.57					AMBIENT PRESSURE:	ESSURE:	29.84 INCHES HG	S HG
POR	OPOR	TOR	TUPT	TAMB	PU-PA	PA-PS	PA-PNZ	SECONDARY AREA	ARFA
INCHES	OF WATER)	(DE	(DEGREES FAHRENHEIT)	RENHEIT)	NI)	(INCHES OF MATER)	TER.)	(SQUARE INCHES)	(CHE S)
9.6	5.0	150.0	150.0	72.0	2.60	2.28	2,28	0.0	
6.2	5.0	151.0	151.0	72.0	3.20	1.68	1.68	0.785	4)
6.7	5.0	152.0	152.0	72.0	3.70	1-14	1.14	1.167	~
7.1	5.0	153.0	153.0	72.0	4.10	0.70	0.70	3.142	~
9-1	5.0	153.0	153.0	72.0	4.60	0.29	0.29	6.284	•
7.8	5.0	149.0	149.0	72.0	4.75	0.14	0.14	9.621	-
8.1	5.0	149.0	149.0	72.0	4.80	0.08	0.08	13.548	a p
7.8	5.0	150.0	150.0	72.3	4.80	9.00	90.0	15.512	8
7.8	5.0	145.0	145.0	72.0	4.80	0.05	0.05	17.082	Ņ
7.9	2.0	146.0	146.0	72.0	4.90	0.0	0.0	*****	•
*	å	*	P+/T+	44.*****	¥	SH	å	Š	3
					(LBM/SEC)) (LBM/SEC)	(FT/SEC)	-	(F1/SEC)
0.0	0.3348	0.8721	0.3839	0.0	0.187	0.0	175.02	58.34	58.34
0.1845	0.2459	0.8706	0.2825	0.1736	0.187	0.035	175.04	67.64	58.34
0.3427	0.1673	0.8692	0.1925	0.3222	0.187	0.064	175.07	15.65	56.35
0.4784	0.1030	0.8678	0.1186	0.4495	0.187	0.089	175.13	82.54	58.37
0.6146	0.0426	0.8678	0.0491	9115-0	0.187	0.115	175.02	89.44	58.34
0.6561	0.0210	0.8735	0.0240	0.6182	0.188	0.123	174.43	91.52	58.14
0.6715	0.0111	0.8735	0.0127	0.6327	0.188	0.126	174.41	92.29	58.13
0.6882	0.0089	0.8721	0.0102	0.6483	0.188	0.129	174.55	53.16	56.18
1689*0	0.0074	0.8793	0.0085	0.6511	0.188	0.130	173.82	93.15	57.94
******	•								

UPT MACH

0.048 0.048 0.048 0.048 0.048 0.048

4. 5. 26.5

0.0

5.5

ITA TAKEN 3 JUNE 77 BY PETE HARRELL

CNE NOZZLE, ELLIPTIC TRANSITION, STANDOFF 0.0

1/1/7-57/0/15

Ź	NUMBER OF PRIMARY NO	PRIMA	RY NOZZLES:					5	UPTAKE DIAMETER:		3.00 INCHES		
مَ	RIMARY NO.	3727	PRIMARY NOZZLE CIAMETER: 1.732 INCHES	1.732 INC	HES			¥	AREA RATIO, AM/AP:		3.00		
2.	PIXING STACK LENGTH;	CK LEI	NGTH; 22.7	22.71 INCHES				ö	AIFICE DIA	IME TER:	ORIFICE DIAMETER: 2-154 INCHES	s	
I	IXING STA	CK 01/	-	-00 INCHE	S			č	ORIFICE BETA: 0.70	(A: 0.70			
I	HIXING STACK L/D:	CK L/1	1.57					Ā	AMBIENT PRESSURE:		29.80 INCHES HG	S HG	
z	PCR	œ	DPOR	108	TUPT	TAMB	9	PU-PA	PA-PS	PA-PNZ	SECONDARY AREA	AREA	
RUN	U.S.	ÆS	CF WATER!	90)	GREES FA	(DEGREES FAHRENHEIT)	_	CINC	(INCHES OF WATER)	ren)	(SQUARE INCHES)	NCHES)	
	16	16.5	15.0	150.0	150.0	70.0	0.	7.50	7.20	7.20	0.0		
8	18	18.1	15.0	151.0	151.0	70.0	0.	9.20	5.40	5.40	0.785	85	
in	61	19.7	15.0	151.0	151.0	70.0	0.	10.70	3.82	3.82	1.767	19.	
4	21	21.0	15.0	151.0	151.0	70.0	0.	12.00	2.43	2.43	3.142	42	
ĸ	22	22.4	15.0	152.0	152.0	70.0	•	13.40	10.1	10.1	6.284	84	
•	22	22.9	15.0	152.0	152.0	70.0	0.	13.90	0.50	0.50	9.621	.21	
1	23	23.2	15.0	153.0	153.0	70.0	0.	14.20	0.27	0.27	13.548	48	
80	23	23.5	15.0	154.0	154.0	70.0	•	14.20	0.20	0.20	15.512	112	
6	23	23.2	15.0	155.0	155.0	70.07	0.	14.20	91.0	0.16	17.082	182	
01	23	23.4	15.0	146.0	146.0	70.0	0.	14.40	0.0	0.0	****		
z	ž	*	å	*	P*/T*	55***1*K	**	a 3	ž	e e	H	20	UPT MACH
RUN						,		(LBM/SEC)	(LBM/SEC)	(FT/SEC)) (FT/SEC)	(F1/SEC)	
~	0.0		0.3578	0.8688	0.4118	8 0.0		0.325	0.0	300.50	100.16	100.16	0.083
2	0.1	0.1909	C. 2691	0.8674	0.3102	12 0.1793	193	0.325	0.062	300.08	116.74	100.02	0.083
e	0.3	0.3608	0.1910	0.8674	0.2202	12 0.3389	389	0.325	0.117	299.57	131.58	99.85	0.082
4	0.5	0.5109	0.1219	0.8674	0.1405	9 0.4799	662	926-0	0.167	299.09	144.76	69.66	0.082
8	9.0	0.6582	0.0508	0.8659	0.0586	9719.0 91	178	0.326	0.215	298.85	157.78	69.69	0.082
9	0.1	0.7072	0.0251	0.8659	0.0289	9 0.6638	863	0.326	0.231	298.64	162-12	45.56	0.082
1	0.7	0.7337	0.0136	0.8645	0.0157	1889-0 1	881	0.326	0.239	298.77	164.47	99.59	0.082
89	0.7	0.7236	0.C100	0.8631	0.0116	6 0.6782	782	0.326	0.236	299.02	163.58	19.66	0.082
6	0.7	0.7132	0.0000	0.8617	0.0093	3 0.6680	980	0.326	0.232	299,26	162.69	99.75	0.082
0.7	***	* * *	0.0	0.8745	0.0	****	**	0.328	*****	296.99	****	66*86	0.082
XI.	MIXING STACK PRESSURE	PRES		DISTRIBUTION FOR RUN:	OR RUN:	01							
	:0/x	0.0	0.5	1.0	1.5	5.0	2.5	3.0	3.5	4.0	4.5 5.0	8.5	0.9
PHSCIN. H20):		0.0	0.0	0.0	0.0	0-0	0.0	0.0	0.0			0.0	0.0
	PMS*:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	0.0	0.0
					(P)	= 0/S	0.0, M	$M_{\parallel} = 0.082$	082				

Table IX. Continued.

DATA TAKEN 3 JUNE 77 BY PETE HARRELL

ONE NOZZLE, ELLIPTIC TRANSITION, STANDSFF 0.0

Z	VUMBER	NUMBER OF PRIMARY	RY NUZZLES:	S: 1					UPTAKE DIAMETER:	AMETER:	3.00 INCHES	NCHES		
•	PRIMARY	N022LE	PRIMARY NOZZLE DIAMETER: 1.732 INCHES	1.732	INCHES				AREA RATIO, AM/AP:	O, AM/AP	3.00			
*	AIX ING	MIXING STACK LENGT		H: 22.71 INCHES	Si				ORIFICE DIAMETER:	IAMETER:		2.154 INCHES		
£	HIXING	MIXING STACK DIAME	AME TER:	TER: 3.00 INCHES	HES				ORIFICE BETA: 0.70	ETA: 0.	70			
£	MIXING	STACK L/0:	1.57						AMBIENT PRESSURE:	RESSURE:		29.80 INCHES HG	911	
z		POR	DPOR	7 OR	-	TUPI	TAMB	P:J-PA	PA-PS	PA- PN2		SECUNDARY AREA	IREA	
RUN		(INCHES (OF WATER		(DEGREES FAHRENHEIT)	FAHRE	WEIT)		(INCHES OF WATER)	AT ER)	bs)	(SQUARE INCHES)	HES)	
		10.9	10.0	153.0		153.0	71.0	06.4	4.69	4.69		0.0		
2		12.1	0.01	152.0		152.0	71.0	6.10	3.51	3.57		0.785		
e		13.2	10.0	152.0		152,0	71.0	7.10	5.49	5.49		1.767		
4		14.0	10.0	150.0		150.0	71.0	8.00	1.61	1.61		3.142		
S		6.41	10.0	150.0		150.0	71.0	8.80	99.0	99.0		6.284		
9		15.3	10.0	151.0	_	51.0	71.0	9.20	0.34	0.34		9.621		
7		15.4	10.0	151.0		151.0	71.0	9.30	0.18	0.18		13.548		
80		15.4	10.0	151.0	_	91.0	71.0	9.30	0.14	0.14		15.512		
6		15.4	10.0	151.0		151.0	71.0	. 05.6	0.12	0.12		17.082		
01		15.6	10.0	147.0		147.0	71.0	09.6	0.0	0.0	*	*******		
z		*	*	*	å	P*/1*	74.**I*W	WP	SM	ď		X	3	UPT MAC
RUN							•	(LBM/SEC)		(LBM/SEC) (FT/SEC)		(F1/SEC)	(F1/SEC)	
-	•	0.0	0.3455	0.8652		6866.0	0.0	0.264	0.0	247.04		82.34	82.34	0.068
8	•	0.1906	0.2642	0.8676		0.3045	0.1790	0.264	0.050	246.41		95.73	82.15	0.068
m	•	0.3578	0.1847	0.8676		0.2129	0.3361	0.265	0.095	246.20		107.66	82.06	0.068
4	•	0.5102	0.1201	0.8704		0.1380	0.4800	0.265	0.135	245.50		118.51	81.83	0.068
w	-	0.6527	0.0493	0.8704		0.0561	0.6140	0.266	0.173	245.28		128.79	81.76	0.068
9	-	0.7175	0.0254	0.8690		0.0292	0.6745	0.266	0.191	245.36		133.48	81.78	0.068
7	•	0.7350	0.0134	0.8690		0.0155	0.6510	0.266	0.195	245.33	-	134.75	81.77	0.068
80	•	0.7422	0.0105	0.8690		0.0120	0.6977	0.266	0.197	245.33		135.27	81.77	0.068
6	•	0.7408	9800.0	0.8690		6500.0	9964.0	0.266	0.197	245.28		135.14	81.75	0.067
10	*	****	0.0	0.8747	0.0		******	0.267	*****	244.41		****	61.47	0.067
×I¥	ING ST	ACK PRESS	MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10	R 18UT 10N	FOR RU	10								
	:0/x	0.0	0.5	1.0	1.5	2.0	2.5	0-4	2,5	0.4	4.5	0,5	5,5	0.0
PMS(1N. H20):	н20):	-1.33	-1.17	-0.88	99.0-	-0.49		-0.21			-0-04	0.02	-0.01	0.00
	: *SHd	-0.10	-0.09	-0.07	0.05	0.04	-0.02	0.02	. 10.0-	- 00.00-	-0.00	00.00	-0.00	00.00
					_	(e) S/	(e) $S/D = 0.0$,	$M_{\odot} = 0.068$	990.0					
						!- -	Table IX	Continued	שווי					
						-	מוחמ		ט					

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DATA TAKEN 3 JUNE 77 BY PETE HARRELL

ONE NOZZLE, ELLIFTIC TRANSITION, STANDOFF 0.0

1/1/7.57/0/05

ORIFICE DIAMETER: 2.154 INCHES	CALFICE BETA: 0.70 CALFICE CALFICA	
PU-PA PA-PS PA-PNZ SECONDARY AREA	TAMB	: 22.71 INCHES
### ### ### ### ### ### ### ### ### ##	TAMB PU-PA PA-PS PA-PNZ SECONDARY AREA PA-PNZ P	3.00 INCHES
6 PU-PA PA-PS PA-PNZ SECONDARY AREA 0 2.5G 2.34 2.34 0.0 0 3.0G 1.75 1.75 0.785 0 4.0G 0.79 0.79 3.142 0 4.5G 0.32 0.32 6.284 0 4.5G 0.16 0.16 9.621 0 4.5G 0.16 0.16 9.621 0 4.5G 0.16 0.09 13.548 0 4.70 0.09 0.09 13.548 0 4.4BO 0.07 0.09 13.548 0 4.4BO 0.07 0.09 13.548 0 4.4BO 0.05 0.09 17.566 17.568 0 4.4BO 0.05 175.44 58.48 58.48 1 4.4BO 0.05 175.44 58.48 58.48 1 0.187 0.05 175.52 76.58 58.49 <	I TAMB PUL-PA PA-PS PA-PNZ SECONDARY AREA 11.0 2.50 2.34 2.34 0.0 11.0 2.50 2.34 2.34 0.0 11.0 3.00 1.75 1.75 0.785 11.0 3.60 1.26 1.26 1.76 11.0 4.00 0.79 0.32 6.284 11.0 4.50 0.12 0.12 1.76 11.0 4.50 0.16 0.16 9.621 11.0 4.50 0.07 0.09 13.548 11.0 4.60 0.07 0.09 13.548 11.0 4.40 0.07 0.09 13.548 11.0 4.40 0.05 0.05 17.082 11.0 4.40 0.05 0.05 17.082 11.0 4.40 0.05 0.05 17.582 11.0 4.40 0.05 0.05 17.582 11.0 4.40 0.09	7.57
Color Colo	11.00 2.50 2.34 2.34 0.0 71.10 2.50 2.34 2.34 0.0 71.10 3.00 1.75 1.75 0.785 71.10 3.60 1.26 1.26 1.76 71.10 3.60 1.26 1.26 1.76 71.10 4.00 0.79 0.12 0.15 71.10 4.50 0.16 0.16 0.16 71.10 4.50 0.16 0.16 0.25 71.10 4.70 0.07 0.09 13.548 71.10 4.20 0.01 0.09 13.548 71.10 4.20 0.07 0.09 13.548 71.10 4.20 0.05 0.09 13.548 71.10 4.20 0.05 0.09 13.548 71.10 4.20 0.05 0.09 14.556 80 0.01 1.75.75 17.566 17.566 80 0.187 0.01	TOR
710 2.50 2.34 2.34 0.0 710 3.00 1.75 1.75 0.785 710 3.60 1.26 1.26 1.767 710 4.00 0.79 0.79 3.142 710 4.50 0.32 0.32 6.284 710 4.50 0.16 0.16 9.621 710 4.60 0.16 0.05 13.548 710 4.60 0.06 0.07 0.07 15.512 710 4.60 0.07 0.07 15.512 710 4.60 0.07 0.07 17.082 710 4.80 0.05 0.05 17.082 710 4.80 0.0 0.0 ************************** W*************** W W U W 0.0 0.187 0.05 175.46 58.48 0.175 0.187 0.05 175.22 16.17 175.80	0 711.0 2.50 2.34 2.34 0.0 711.0 3.00 1.75 1.75 0.785 711.0 3.00 1.26 1.26 1.767 711.0 4.00 0.79 0.79 3.142 711.0 4.50 0.23 0.32 6.284 711.0 4.50 0.05 0.05 13.548 711.0 4.50 0.07 0.07 13.548 711.0 4.70 0.07 0.07 13.548 711.0 4.20 0.05 0.07 13.548 711.0 4.20 0.05 0.07 115.512 711.0 4.20 0.05 0.07 115.62 711.0 4.20 0.05 0.07 115.62 711.0 4.20 0.05 0.07 115.62 711.0 4.20 0.05 0.07 115.62 711.0 4.20 0.05 0.05 115.44 80 0.181	(DEGREES
71.0 3.00 1.75 1.75 0.785 71.0 3.60 1.26 1.26 1.767 71.0 4.00 0.79 0.79 3.142 71.0 4.50 0.32 0.32 6.284 71.0 4.60 0.16 0.16 9.621 71.0 4.70 0.09 0.09 13.548 71.0 4.70 0.07 0.07 15.512 71.0 4.40 0.07 0.07 15.512 71.0 4.40 0.07 0.07 17.082 71.0 4.40 0.05 0.05 17.082 71.0 4.40 0.05 17.567 67.756 67.756 71.0 4.40 0.05 175.44 58.48 58.48 0.0 0.187 0.05 175.52 175.56 67.93 58.44 0.0 0.187 0.065 175.22 175.58 58.40 0.5566 0.187 0.134	111.0 3.00 1.75 1.75 0.785 111.0 3.60 1.26 1.26 1.767 111.0 4.00 0.79 0.79 3.142 111.0 4.50 0.32 0.32 6.284 111.0 4.50 0.16 0.16 9.621 111.0 4.50 0.16 0.16 9.621 111.0 4.50 0.05 13.548 13.548 111.0 4.70 0.07 0.07 15.512 111.0 4.80 0.05 0.07 17.082 111.0 4.80 0.05 0.07 17.082 111.0 4.80 0.05 0.05 17.082 111.0 4.80 0.05 0.05 17.484 58.48 111.0 4.80 0.05 175.44 58.48 58.48 111 0.066 0.187 0.03 175.39 67.93 58.48 111 0.066 0.187 0.049	152.0 15
71.0 3.60 1.26 1.26 1.767 71.0 4.00 0.79 0.79 3.142 71.0 4.50 0.32 0.32 6.284 71.0 4.50 0.16 0.16 9.621 71.0 4.50 0.05 0.09 13.548 71.0 4.40 0.07 0.09 13.548 71.0 4.80 0.05 0.05 17.822 71.0 4.80 0.05 0.05 17.822 71.0 4.80 0.05 0.05 17.822 0.0 0.187 0.0 175.44 58.48 58.48 0.175 0.187 0.007 175.22 16.58 58.40 0.4769 0.187 0.005 175.41 84.00 58.28 0.6566 0.187 0.134 174.84 93.67 58.28 0.6631 0.188 0.134 174.53 94.57 58.17 0.6831 0.188 0.134 174.53 94.57 58.07 0.6831 0.188 0.136 174.23 94.57 58.07	0 71.0 3.60 1.26 1.26 1.767 0 71.0 4.00 0.79 0.79 3.142 0 71.0 4.50 0.32 0.32 6.284 0 71.0 4.50 0.16 0.16 9.621 0 71.0 4.60 0.16 0.09 13.548 0 71.0 4.70 0.07 0.07 15.512 0 71.0 4.80 0.05 0.05 17.082 1 71.0 4.80 0.05 0.05 17.082 1 71.0 4.80 0.05 0.05 17.484 17.5512 1 1 4.80 0.05 175.44 58.48 58.48 5 0.187 0.087 175.44 58.48 58.48 5 0.187 0.085 175.44 58.48 58.48 5 0.187 0.087 175.22 16.758 58.48 1 <td< td=""><td>152.0 15</td></td<>	152.0 15
71.0 4.00 0.79 0.79 3.142 71.0 4.50 0.32 0.32 6.284 71.0 4.60 0.16 0.16 9.621 71.0 4.70 0.09 0.09 13.548 71.0 4.80 0.05 0.05 17.512 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 0.187 0.0 175.44 58.48 58.48 0.1775 0.187 0.0 175.44 58.48 58.40 0.4769 0.187 0.057 175.33 67.93 58.40 0.6566 0.187 0.0121 175.01 91.00 58.31 0.6566 0.187 0.134 174.84 93.67 58.28 0.6631 0.188 0.134 174.53 94.57 58.17 0.6831 0.188 0.134 174.53 94.57 58.17 0.6831 0.188 0.136 174.23 94.57 58.07	0 71.0 4.00 0.79 0.79 3.142 0 71.0 4.50 0.32 6.284 0 71.0 4.50 0.16 0.16 9.621 0 71.0 4.50 0.09 0.09 13.548 0 71.0 4.70 0.07 0.07 15.512 1 71.0 4.80 0.05 0.05 17.082 1 71.0 4.80 0.05 0.05 17.082 1 71.0 4.80 0.05 0.05 17.082 1 71.0 4.80 0.05 0.05 17.082 1 71.0 4.80 0.05 0.0 17.082 1 71.0 4.80 0.05 0.0 0.0 0.0 2 71.0 4.80 0.05 0.05 17.246 58.48 2 0.181 0.081 175.43 58.48 58.44 2 0.4769 0.187	152.0 15
71.0 4.50 0.32 0.32 6.284 71.0 4.60 0.16 0.16 9.621 71.0 4.70 0.09 0.09 13.548 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 0.187 0.0 175.44 58.48 58.48 0.1775 0.187 0.035 175.33 67.93 58.48 0.3388 0.187 0.057 175.22 76.58 58.40 0.0566 0.187 0.057 175.22 76.58 58.40 0.6566 0.187 0.0121 175.01 91.00 58.33 0.6566 0.187 0.134 174.84 93.67 58.28 0.65745 0.188 0.134 174.53 94.57 58.17 0.6831 0.188 0.134 174.53 94.57 58.17 0.6831 0.188 0.136 174.23 94.57 58.07	11.0 4.50 0.32 6.284 71.0 4.60 0.16 0.16 9.621 71.0 4.70 0.09 13.548 71.0 4.70 0.09 13.548 71.0 4.80 0.07 0.07 15.512 71.0 4.80 0.05 17.08 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.0 17.082 71.0 4.80 0.05 0.0 17.082 80 0.0 0.187 0.0 175.44 58.48 80 0.0 0.187 0.05 175.44 58.48 80 0.187 0.067 175.22 16.58 58.46 80 0.187 0.087 175.21 175.28 58.28 81 0.566 0.187 0.128 174.84 94.57 58.28	152.0 19
71.0 4.60 0.16 0.16 9.621 71.0 4.70 0.09 0.09 13.548 71.0 4.80 0.07 0.07 15.512 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.550 0.187 0.087 175.39 67.93 58.48 0.187 0.087 175.22 76.58 58.49 0.4769 0.187 0.067 175.21 76.58 58.40 0.6566 0.187 0.0121 175.01 91.00 58.33 0.6566 0.187 0.134 174.84 93.67 58.28 0.6739 0.187 0.134 174.80 94.60 58.26 0.6739 0.188 0.134 174.53 94.57 58.17 0.6831 0.188 0.134 174.53 94.57 58.17 ***********************************	71.0 4.60 0.16 0.16 9.621 71.0 4.70 0.09 13.548 71.0 4.70 0.09 13.548 71.0 4.80 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.0 17.082 1 1.00 0.05 0.0 17.082 17.082 1 1.00 0.0187 0.0 175.40 0.0 58.48 2 0.187 0.035 175.11 84.00 58.48 58.48 2 0.187 0.037 175.22 16.58 58.48 58.48 3 0.187 0.037 175.21 84.00 58.28 58.48 4 0.606 0.187 0.121 174.84 93.67 58.28 10 0.606 0.186 0.134 174.53 94.57 58.17<	152.0 15
71.0 4.70 0.09 0.09 13.548 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 0.01	71.0 4.70 0.09 0.09 13.548 71.0 4.70 0.07 0.07 15.512 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 9 71.0 4.80 0.05 0.0 ************************************	151.0
71.0 4.70 0.07 0.07 15.512 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.0	71.0 4.70 0.07 0.05 15.512 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 171.0 4.80 0.05 0.0 ************ 1	151.0 15
71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.05 0.05 17.082 71.0 4.80 0.0 0.0 ******** W*T**.44 WP WS UP UM UW 0.187 0.036 175.44 58.48 58.48 0.338 0.187 0.035 175.33 67.93 58.40 0.4769 0.187 0.067 175.22 76.58 58.40 0.6566 0.187 0.012 175.01 91.0V 58.33 0.6566 0.187 0.134 174.84 93.67 58.28 0.6739 0.187 0.134 174.80 94.60 58.26 0.6745 0.188 0.134 174.53 94.57 58.17 0.6831 0.188 0.134 174.53 94.57 58.07 ************************************	710 4.80 0.05 17.082 710 4.80 0.05 17.082 1710 4.80 0.0 0.0 17.084************************************	149.0
71.0 4.80 5.0 0.0 ************************************	11.0 4.80 5.0 0.0 ************************************	147.0 14
M*I**,44 WP WS UP UM UU (LBH/SEC) (LBM/SE-) (FT/SFC) (FT/SFC) (FT/SEC) (FT/SEC) 0.0 0.187 0.0 175.44 58.48 58.48 0.1775 0.187 0.067 175.22 76.58 58.46 0.3388 0.187 0.067 175.22 76.58 58.40 0.4769 0.187 0.121 175.01 91.00 58.31 0.6566 0.187 0.131 174.84 93.67 58.28 0.6739 0.187 0.134 174.80 94.57 58.26 0.6831 0.188 0.134 174.53 94.57 58.17 0.6831 0.188 0.136 174.23 94.97 58.07 ********* 0.188 0.136 174.23 94.97 58.07	W*T**,44 WP WS UP UM UU	143.0 143
0.0 0.187 0.0 175.44 58.48 58.48 0.1775 0.187 0.035 175.44 58.48 58.48 0.1378 0.187 0.035 175.33 67.93 58.48 0.3388 0.187 0.067 175.22 76.58 58.40 0.4769 0.187 0.057 175.21 84.00 58.33 0.6566 0.187 0.131 174.84 93.67 58.28 0.6739 0.187 0.134 174.80 94.57 58.17 0.6831 0.188 0.134 174.53 94.97 58.07 ********* 0.188 ******** 57.89	1,000, 0.0 1,0	*1/*0 *1
0.0 0.187 0.0 175.44 58.48 58.48 0.1775 0.187 0.035 175.33 67.93 58.44 0.388 0.187 0.067 175.22 76.58 58.40 0.4769 0.187 0.067 175.01 91.00 58.33 0.6566 0.187 0.131 174.84 93.67 58.28 0.6739 0.187 0.134 174.80 94.60 58.26 0.6831 0.188 0.134 174.53 94.97 58.17 0.6831 0.188 0.136 174.23 94.97 58.07	39 0.0 0.187 0.0 175.44 58.48 58.48 50 0.1775 0.187 0.035 175.33 67.93 58.44 26 0.3388 0.187 0.067 175.22 76.58 58.40 35 0.4769 0.187 0.067 175.21 84.00 58.37 41 0.6066 0.187 0.095 175.11 84.00 58.37 41 0.6566 0.187 0.131 174.84 93.67 58.28 10 0.6745 0.188 0.134 174.84 93.67 58.28 10 0.6739 0.188 0.134 174.83 94.57 58.17 33 0.6831 0.188 0.136 174.53 94.57 58.07 ********* 0.188 0.136 174.53 94.57 58.07 ********* 0.188 ******** 173.67 ******* 57.89 10 0.0 0.0 0.0 0.0 </td <td></td>	
0.1775 0.187 0.035 175.33 67.93 58.44 0.3368 0.187 0.067 175.22 76.58 58.40 0.4769 0.187 0.095 175.11 84.00 58.37 0.6066 0.187 0.121 175.01 91.00 58.33 0.6566 0.187 0.131 174.84 93.67 58.28 0.6739 0.187 0.134 174.80 94.60 58.26 0.6745 0.188 0.134 174.53 94.57 58.17 0.6831 0.188 0.136 174.23 94.97 58.07 ********* 0.188 ******** 57.89	50 0.1775 0.187 0.035 175.33 67.93 58.44 26 0.3388 0.187 0.067 175.22 76.58 58.40 35 0.4769 0.187 0.005 175.11 84.00 56.37 41 0.6066 0.187 0.0121 175.01 91.00 58.33 71 0.6566 0.187 0.134 174.84 93.67 58.28 10 0.6739 0.187 0.134 174.89 94.60 58.26 10 0.6831 0.188 0.134 174.53 94.57 58.17 23 0.6831 0.188 0.136 174.53 94.57 58.07 ********* 0.188 ******** 173.67 ******* 57.89 10 0.0<	0.8676 0.3939
0.3388 0.187 0.067 175.22 76.58 58.40 0.4769 0.187 0.095 175.11 84.00 58.37 0.6066 0.187 0.121 175.01 91.00 58.33 0.6566 0.187 0.121 174.84 93.67 58.28 0.6739 0.187 0.134 174.80 94.60 58.26 0.6745 0.188 0.134 174.53 94.57 58.17 0.6831 0.188 0.136 174.23 94.97 58.07 ************************************	26 0.3888 0.187 0.067 175.22 76.58 58.40 35 0.4769 0.187 0.095 175.11 84.00 58.37 41 0.6066 0.187 0.121 175.01 91.00 58.33 71 0.6566 0.187 0.131 174.84 93.67 58.28 44 0.6536 0.187 0.134 174.89 94.60 58.28 10 0.6435 0.188 0.134 174.53 94.57 58.07 23 0.6831 0.188 0.136 174.53 94.97 58.07 24********* 0.188 ******** 173.67 ******* 57.89 10 0.0 0.0 0.0 0.0 0.0 0.0 0.0 25 3.0 3.5 4.0 4.5 5.0 5.5 6. 20 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.8676 0.2950
0.4769 0.187 0.095 175.11 84.00 58.37 0.6066 0.187 0.121 175.01 91.0v 58.33 0.6566 0.187 0.134 174.84 93.67 58.28 0.6739 0.187 0.134 174.80 94.60 58.26 0.6145 0.188 0.134 174.53 94.57 58.17 0.6831 0.188 0.136 174.23 94.97 58.07 ********* 0.188 ******** 57.89	35 0.4769 0.187 0.095 175.11 84.00 58.37 41 0.6066 0.187 0.121 175.01 91.00 58.38 11 0.6566 0.187 0.134 174.84 93.67 58.28 44 0.6539 0.187 0.134 174.80 94.60 58.26 10 0.6739 0.188 0.134 174.53 94.57 58.17 33 0.6831 0.188 0.136 174.53 94.97 58.07 ********* 0.188 ******* 173.67 ******* 57.89 10 ******* 173.67 ******* 57.89 2.0 2.5 4.0 4.5 5.0 5.5 6. 2.0 0.0 <th< td=""><td>0.8676 0.2126</td></th<>	0.8676 0.2126
0.6066 0.187 0.121 175.01 91.0v 58.33 0.6566 0.187 0.134 174.84 93.67 58.28 0.6739 0.187 0.134 174.80 94.60 58.26 0.6745 0.188 0.134 174.53 94.57 58.17 0.6831 0.188 0.136 174.23 94.97 58.07 ******** 0.188 ******** 173.67 ******* 57.89	11 0.6066 0.187 0.121 175.01 91.00 58.33 11 0.6566 0.187 0.134 174.84 93.67 58.28 44 0.6539 0.187 0.134 174.80 94.60 58.26 10 0.6735 0.188 0.134 174.53 94.57 58.17 33 0.6831 0.188 0.136 174.23 94.97 58.07 ********* 0.188 ******** 173.67 ****** 57.89 10 ******* 173.67 ****** 57.89 20 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6. 0.0	0.8676 0.1335
0.6566 0.187 0.134 174.84 93.67 58.28 0.6739 0.187 0.134 174.80 94.60 58.26 0.6745 0.188 0.134 174.53 94.57 58.17 0.6831 0.188 0.136 174.23 94.97 58.07 ******* 0.188 ******* 173.67 ****** 57.89	11 0.6566 0.187 0.134 174.84 93.67 58.28 14 0.6739 0.187 0.134 174.80 94.60 58.26 10 0.6745 0.188 0.134 174.53 94.57 58.17 33 0.6831 0.188 0.136 174.23 94.97 58.07 ********* 0.188 ******* 173.67 ****** 57.89 10 ******* 173.67 ****** 57.89 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6. 0.0 0.	0.8676 0.0
0.6739 0.187 0.134 174.80 94.60 58.26 0.6745 0.188 0.134 174.53 94.57 58.17 0.6831 0.188 0.136 174.23 94.97 58.07 ******** 0.188 ******* 173.67 ****** 57.89	10 0.6739 0.187 0.134 174.80 94.60 58.26 10 0.6831 0.188 0.134 174.53 94.57 58.17 33 0.6831 0.188 0.136 174.23 94.97 58.07 ********* 0.188 0.136 174.23 94.97 58.07 ********* 0.188 ******** 173.67 ******* 57.89 10 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6. 0.0 <td>0.8690 0.0271</td>	0.8690 0.0271
0.6745 0.188 0.134 174.53 94.57 58.17 0.6831 0.188 0.136 174.23 94.97 58.07 ******* 0.188 ****** 173.67 ***** 57.89	10 0.6745 0.188 0.134 174.53 94.57 58.17 33 0.6831 0.188 0.136 174.23 94.97 58.07 ******** 0.188 ****** 173.67 ****** 57.89 10 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.8690 0.0144
0.6831 0.188 0.136 174.23 94.97 58.07 ******* 0.188 ****** 173.67 ****** 57.89	33 0.6831 0.188 0.136 174.23 94.97 58.07 ******* 0.188 ****** 173.67 ****** 57.89 10 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.6719 0.6110
0.188 ****** 173.67 ***** 57.89	10 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.8747 0.0093
	10 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.8805 0.0
	0.0 0.0 0.0 0.0 0.0 0.0 0.0	1.0 1.5
2.5 3.0 3.5 4.0 4.5 5.0 5.5	0.0 0.0 0.0 0.0 0.0 0.0	0.0 0.0
2.5 3.0 3.5 4.0 4.5 5.0 5.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0		0.0 0.0

Table IX. Continued.

CATA TAKEN 3 JUNE 77 BY PETE HARRELL

1/1/7.57/-024/15	
-0.24	
STANDOFF	
INE NOZZLE, ELLIPTIC TRANSITION, STANDOFF	
ELLIPTIC	
NOZZLE	
JNE	

UPT MACH 0.083 0.082 0.082	3.00 2.154 INCHES HG 29.81 INCHES HG SECONDARY AREA (SQUARE INCHES) 0.0 0.785 1.767 3.142 6.284 9.621 13.548 15.512 17.082 ************ UM UU (FT/SEC) (FT/SEC) 99.97 116.57 99.77 131.55 99.44
0.082	95.56
•	99.29
0.08	99.44
0.08	99.59
0.083	11.66
0.08	16.66
	(FT/SEC)
UPT MAC	3
	*
	21
	N.
	4
	2
	~
	35
	ACHES !
	AREA
	5 HG
	S

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

	0.0		
5.5	0-0	0.0	
4.0 4.5 5.0	0.0	0.0	= 0.082
4.5	0.0	0.0	4, X
4.0	0.0	0.0	= -0.2
3.0 3.5 4	0.0	0.0	0/S (6
3.0	0.0	0.0	٣
2.5	0.0	0.0	
0.5	0.0	0.0	
0.0	0.0	0.0	
:0/x	PMS(IN. H20):	PM S + :	

Table IX. Continued.

DATA TAKEN 3 JUNE 77 BY PETE HARRELL

UME NULZLE, ELLIPTIC TRANSITION, STANDOFF -0.24

1/1/7.57/-024/10

			Эн	AREA	CHES)		۳		~	4		8	2	~	•	UU WAT MACH	(F1/SEC)	81.93 0.068	81.81 0.068	81.72 0.068	81.62 0.068	81.54 0.068	81.51 0.068	81.49 0.068	81.49 0.068	81.49 0.068
3.00 INCHES	2.154 INCHES		29.81 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	*****	MO	(FT/SEC)	81.93	15.41	107.47	118.54	125.08	132.60	134.64	133.20	133.87
4616K: 3. , AM/AP:		TA: 0.70		PA-PNZ	IER)	4.12	3.58	2.50	1.62	19.0	0.33	0.18	0.13	0.11	0.0	9	(L8M/SEC) (FT/SEC)	245.79	245.43	245.19	544.89	244.65	244.56	244.50	244.50	244.50
OFIAKE DIAMEIEK: ARFA RATIO, AM/AP:	ORIFICE DIAMETER:	URIFICE BETA: 0.70	AMRIENT PRESSURF:	PA-PS	(INCHES OF WATER)	4.72	3.58	2.50	1.62	19.0	0.33	0.18	0.13	0.11	0.0	SH		0.0	0.050	0.095	0.136	471.0	0.187	0.195	0.190	0.192
Ā	ē	ā	¥	PU .PA	CINC	5.00	6.10	7.00	7.90	B. 70	00.6	9.20	9.20	9.20	9.30	a. X	(LBM/ SEC)	0.265	0.266	0.266	0.266	0.266	0.266	0.267	0.267	0.257
				TAMB	NHE I T)	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	55"**I*M		0.0	0.1791	0.3366	0.4813	0.6185	0.6643	0.6907	0.6721	0.6808
ES				TUPT	(DEGREES FAHRENHEIT)	1.1.0	147.0	147.0	147.0	147.0	147.0	147.0	147.0	147.0	147.0	P*/1*		0.4014	0.3054	0.2137	0.1388	0.0575	0.0283	0.0155	0.0112	0.0095
ZL ES: 1 ER: 1.732 INCHES	22.71 INCHES	3.00 INCHES		1 OK	1056	147.0	147.0	147.0	147.0	147.0	147.0	147.0	147.0	147.0	147.0	*		0.8780	0.8780	0.8780	0.8780	0.8780	0.8780	0.8780	0.8780	0.8780
NY NOZZLES DIAMFIER:	NGTH: 22.7	••	7.57	DPOR	OF WATER)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	0.01	*		0.3524	0.2681	0.1876	0.1219	0.0505	0.0249	0.0136	9600.0	0.0083
NUMBER OF PRIMARY NUZZLES: PRIMARY NUZZLE DIAMFIER: 1.	MIXING STACK LENGTH;	MIXING STACK DIAMETER	MIXING STACK L/D:	POR	(INCHES OF WAT	11.11	12.1	13.1	13.9	14.7	15.0	15.2	15.2	15.2	15.4	*		0.0	0.1897	0.3564	0.5097	0.6549	0.7035	0.7314	0.7117	0.7209
PRIMA	MIXIM	MIXIA	MIXIA	z	RUN		7	M	4	ĸ	•	2	3 0	σ	10	,z	RUN	-	7	m	4	•	ø	7	∞.	6

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 -1.30 -1.09 -0.87 -0.67 -0.47 -0.34 -0.22 -0.16 -0.10 -0.08 -0.07 -0.05 -0.04 -0.03 -0.02 -0.01 (h) S/D = -0.24, $M_b = 0.068$

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

-1.41

, PHS(IN. H20): PMS*: Table IX. Continued.

0°0-0°0-

-0.04

5.0

4.5

0.0

8.0 0.0

HIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

3.0

2.5

0.0

0.0

X/D: PHS(IN- H20): PHS*:

																	HOT MACH	;	0.048	840.0			0.00	B 10.0	8.0.0	9.00	0.048	0.040	0.048	
		S	S HG	Y AREA	I NCHES)		0.785	1.767	3,142	6.284	9.621	13.548	18.812	200	200.11		=	•								21.95	58.17	50.04	58.07	
	O INCHES	3.00 2.154 INCHES	29.81 INCHES HG	CECONDARY AREA	COUNTRY INCHES		d	; <u>-</u>		. 4	ó		¥		200-11		:		_	58.32	67.96	16.50	83.78	91.20	93.68	94.61	94.66	45.02	• • • • •	
	ETER: 3.(AM/AP: :	A'I 0.70 SSURE: 2		7N4-44	ER !	*	2 .	2 .	2 2	36.0	9 6	60.0	0.0	0.0	0.0		<u>-</u>	_	174.98	175.00	174.93	174.97	174.86	174.55					
•	UPTAKE DIAMETER: 3.00 INCHES	AREA RATIO, AM/AP: Urifice Diameter:	ORIFICE BETA': 0.70 AMBIENT PRESSURE:		PA-PS	(INCHES OF WAIGH)	2.34	1.79	97.1	97.0	0.32	91.0	60.0	20.0	0.05	0.0		S I	1 (LBM/SEC)	0.0	0.036	0.067	960.0	0.121	161.0	461.0			;	
124/05	å	AA U	A G		PU−PA	INC.	2.50	3.10	3.50	3.90	4.40	4.50	4.60	4.60	4.60	4.70		d X	(LBM/SEC)	0.187	0.187	0.187	0.187	0-197	0.198		0.188	891.0	001.0	
1/1/7.57/-024/05					TAMB	HE (T)	73.0	13.0	73.0	13.0	73.0	13.0	73.0	13.0	73.0	73.0		74144.44		0.0	0.1795	OBE E O	0.4722	7007	17970	10000	0.6736	0.6745	0.6029	• • •
-0.24		10			TipT	(DEGREES FAHRENHEIT)	149.0	150.0	150.0	151.0	151.0	149.0	149.0	149.0	146.0	0.741		\$1/*d	•	9595.0	3 6 6	0.3018	0112.0	0.1309	0.0546	0.0271	0.0144	0.0110	0.0093	0.0
		732 INCHE	3.00 INCHES		10R	(DEGR	0.651	150.0	150.0	151.0	151.0	149.0	149.0	149.0	146.0	147.0	•	*	<u>.</u>	1920	10.00	0.8737	0.8737	0.8723	0.8723	0.8751	0.8751	0.8751	0.8795	0.8780
DETE HARRELL	r MOIIICH	NOZZLES: Ameter: 1.	TH: 22.71 ETER: 3.0	1.51	and a	ATTRU		0.0	5-0	0 %	0.0	0,5	, v	, u	0.0) ·	•	į	•		0.3448	0.2637	0.1850	0.1142	0.0417	0.0237	0.0126	9603.0	0.0082	0.0
UNE 77 BY F	LIPTIC IKA	NUMBER OF PRIMARY NOZZLES: 1 PRIMARY NOZZLE DIAMETER: 1.732 INCHES	MIXING STACK LENGTH: 22.71 INCHES HIXING STACK DIAPETER: 3.00 INCH	MIXING STACK L/D:	0	00	ווארחבי בו	C - 4	• 4	•	•	. r	<u>:</u> ;	١٠٠	7.6	1:1			•		0.0	0.1904	0.3587	0.5015	0.6471	0.6561	0-7144	0.7152	0.7226	*****
CATA TAKEN 3 JUNE 77 BY PETE	ONE MOZZLE, ELLIPTIC IRANSITIONI STATES	NUMBER PRIMARY	MIXING	MIXING		z	RUN	؛ سه	7 (m ·	4	in ·	۰	2	80	6	01		z	RUN	-	2	m	4	v	. <	, ~	. cc	o 0*	10

DATA TAKEN 8 JUN 77 BY PETE HARRELL

1/1/7.57/-084/15
-0.84
STANDUFF
TRANSITION,
ELLIFTIC
NE NOZZLE,
z

												UPT MACH		0.083	0.083	0.083	0.08)	0.0	0.082	0.00	0.082	0.062	0.082
25	NREA		•	~	~		_		۸.	~	•	3	(FI/SEC)	100.32	100.14	66.66	99.66	62.66	\$9.76	99.65	44.66	44.64	99.38
3.00 thanes 3.00 2.154 thanes 0 29.65 thanes ha	SCCONDARY AREA	0.0	0.785	1.767	3.142	4.284	5.621	13.548	18.812	17.082	•	5	(FI/SEC)	100.32	116.88	131.14	142.48	153.24	156.67	157.02	156.98	158. 11	•••••
ETER: 3.00 AM/AP: 3. METER: 2. A: 0.70 SSURE: 29	2 Nd -	.00	5.38	3.66	31.5	0.85	0.41	12.0	91.0	91.0	0.0	'n	(F1/SEC)	300.97	300.45	300.00	299.67	299.37	299.30	296.98	298.94	298.94	298.17
UPTAKE DIAMETER! 3 AREA RATIO, AM/AP! ORIFICE DIAMETER! ORIFICE BETA! U.70 AMBIEN! PRESSURE!	A4 S4-A9	2.00	5.38	3.66	2.16	0.85	14.0	0.21	91.0	91.0	0.0	SA	(LUM/SEC)	0.0	0.062	0.115	0.157	0.197	0.209	0.211	0.210	0.217	•••••
5 4 5 5 4	PU-PA	7.60	00.6	10.20	11.10	11.90	12.10	12.20	12.30	12.30	12.40	<u>*</u>	(LBM/SEC)	0.324	0.325	0.325	0.325	0.326	926.0	0.326	0.326	0.326	0.327
	TAMB	70.0	70.0	70.0	0.0%	70.0	0.01	0.07	70.07	10.0	0.07	74.44.44		0.0	0.1790	0.3318	0.4528	0.5676	0.6034	0.6080	0.6076	0.6258	******
E.S.	TUPT TAM	149.0	149.0	149.0	149.0	0.641	149.0	148.0	148.0	148.0	145.0	P*/T*		0.4004	0.3088	0.2107	0.1246	0.0491	0.0237	0.0122	0.0093	0.0081	0.0
522LES: 1 ETER: 1.732 INCHES 22.71 INCHES ER: 3.00 INCHES 7.57	TOR	149.0	149.0	149.0	149.0	149.0	149.0	148.0	148.0	148.0	145.0	<u>.</u>		0.8702	0.8702	0.8702	0.8702	0.8702	0.8702	0.8716	0.8716	0.8716	0.8760
RY NOZZLES CIAMETER: NGTH: 22.7 APETER: 3	OPOR	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	*		0.3485	0.2688	0.1834	0.1085	0. 0428	0.0206	0.0106	0.0081	0.0071	0.0
NUMBER OF PRIMARY NOZZLES: PRIMARY NOZZLE CIAMETER: 1 HIXING STACK LENGTH; 22.71 MIXING STACK DIAPETER: 3.6 HIXING STACK L/O: 7.57	POR	16.6	18.0	15.2	20.1	20.9	21.1	21.1	21.2	21.2	21.3	*		0.0	0.1903	0.3528	0.4814	0.6034	0.6414	0.6459	0.6454	0.6648	******
NUMBE PRIMA MIXIN MIXIN	z =		2	ĸ	4	S	9	7	8	6	01	z	RUN	-	7	ھ	4	٧,	9	7	8	٥	01

:0/x	0.0	0.5	2.5	3.0	3.5	4.0	4.5	5.0	ະ ຄຸ	6.0
PHS(IN. HZC): 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PHS*:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DATA TAKEN 7 JUN 77 BY PETE HARRELL

ONE NGZZLE, ELLIPTIC TRANSITION, STANDOFF -0.84

1/1/7.57/ 084/10

					•											IIPT MACI		0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068
			911	ARFA	CHES		sē.	~	~	•		æ	~	~	ï		(FT/SEC)	81.94	41.84	81.76	81.70	81.65	81.65	81.63	81.63	69.10	61.55
3.00 INCHES	2.154 INCHES		29.74 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	4.284	9.621	13.548	15.512	17.082	****	¥	(F1/SEC)	81.94	95.41	106.87	116.89	125.37	127.73	128.35	129.05	128.87	****
^		TA: 0.70		PA-PN?	TERJ	4.58	3.55	2.39	1.48	0.57	0.27	91.0	0.11	0.09	0.0	9	Ξ	245.84	245.54	245.30	245.11	244.96	244.96	244.90	244.90	244.90	244.67
UPIAKE DIAMETEK: ARFA RATIO, AM/AP:	URIFICE DIAMFTER:	UNIFICE BETA: 0.70	AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	4.58	3.55	2.35	1.48	0.57	0.27	0.14	0.11	60.0	0.0	£ S	(1.8M/SEC)	0.0	0.050	0.093	0.130	0.161	0.170	0.172	0.175	0.174	*****
	-	5	•	PJ-PA	3 ₩. I. I	5.00	00.9	6.80	7.40	7.90	8.00	8.10	9.10	9.10	8.20	ž	(LBM/SEC)	0.265	0.265	992.0	0.266	0.266	0.266	0.266	0.266	0.266	0.256
				TAMB	NIETT)	10.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	55°44 13H		0.0	0.1785	0.3293	0.4604	0.5711	0.6017	0.6101	0.6192	0.6168	*****
ĒS				TUPT	(DEGREES FAHRENHEIT)	146.0	146.0	146.0	146.0	146.0	146.0	146.0	146.0	146.0	145.0	P+/1+		0.3896	0.3027	0.2042	0.1266	0.0488	0.0231	0.0120	0.0094	0.0077	0.0
ER: 1.732 INCHES	22.71 INCHES	3.00 INCHES		198	(066	146.0	146.0	146.0	146.0	146.0	146.0	146.0	146.0	146.0	145.0	<u>*</u>		0.8745	0.8745	0.8745	0.8745	0.8745	0.8745	0.8745	0.8745	0.8745	0.8760
DIAMETER:	NGTH; 22.7	TER:	0: 7.57	DPOR	(INCHES OF WATE')	10.0	10.0	10.0	10.0	10.0	10.0	10.0	0.01	10.0	10.0	*d		0.3407	0.2647	0.1786	0.1108	0.0427	0.0202	0.0105	0.0082	1900.0	0.0
PRIMARY NUZZLE DIAMET	MIXING STACK LENGTH;	MIXING STACK DIAMETER:	MIXING STACK L/D:	POR	(INCHES	11.0	12.0	12.8	13.4	13.5	14.1	14-1	14.1	14.1	14.2	*		0.0	0.1893	0.3493	0.4884	0.6058	0.6382	0.6472	0.6568	0.6542	*****
PRIMA	JXIN	MIXIM	#IXI	z	RUN	-	~	'n	4	'n	9	7	80	σ	10	z	RUN	~	8	m	4	s	9	~	80	٥	01

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

0.0 5.5 01.0--0-05 -0.28 4.0 •0•0-3.5 -0.55 -0.72 -0.55 -1.10 1.5 -1.18 1.0 0.5 -0.10 -1.50 0.0 X/0: PMS(IN. H20): PMS*:

(k) S/D = -0.94, $M_u = 0.068$

Table IX. Continued.

DATA TAKEN 8 JIN 77 BY PETE HARRELL

1/1/7.57/ 384/05
-0.84
STANDOFF
TRANSITION,
ELLIPTIC
ONE NOZZLE,

NUPBE	NUPBER OF PRIMARY NO	ARY NOZZLES:	-			Ď	UPTAKE DIAMETER: 3.00 INCHES	ETER: 3.0	O INCHES		
PRIMA	PRIMARY NUZZLE DIAMET	DIAMETER: 1	ER: 1.732 INCHES	ES	•	<	AREA RATIO, AM/AP:		3.00		
MIXIA	MIXING STACK LENGTH:	ENGTH: 22.71	22.71 INCHES			ā	DRIFICE DIAMETER:		2.154 INCHES		
MIXIA	MIXING STACK DIAMETER	::	3.00 INCHES			Ō	ORIFICE BETA:	A: 0.70			
MIXIA	HIXING STACK L/D:	75.7 107				∢	AMBIENT PRESSURE:		29.65 INCHES HG	924	
z	PUR	DPOR	TUR	TUPT	TAMB	PU-PA	PA-PS	PA-PNZ	SECONDARY AREA	IREA	
RUN	(INCHES	UF WATER)	(066)	(DEGREES FAHRENHEIT)	ENHE IT)	CINC	(INCHES OF WATER)	ER.)	(SQUARE INCHES)	HES)	
	5.5	5.0	146.0	146.0	70.0	2.50	2.28	2.28	0.0		
2	0.9	5.0	146.0	146.0	10.0	3.00	1.76	1.76	0.785		
м	6.4	5.0	146.0	146.0	70.0	3.35	1.20	1.20	1.767		
4	9.9	5.0	146.0	146.0	10.0	9∙60	0.72	0.12	3.142		
8	6.9	5.0	145.0	145.0	70.0	3.90	0.28	0.28	6.284		
9	7.0	5.0	145.0	145.0	10.0	4.00	0.13	0.13	129.5		
7	7.0	5.0	145.0	145.0	70.0	4.00	10.0	0.07	13.548	_	
89	7.0	5.0	145.0	145.0	70.0	4.00	0.05	0.05	15.512		
6	7.0	5.0	145.0	145.0	10.0	4.00	0.04	0.04	17.082		
01	7.1	5.6	145.0	145.0	70.0	4.10	0.0	0.0	计单元件 计分析单位		
z	3	4	<u>*</u>	\$1/#d	44.44.14W	ŝ	, S	ď	Mn	99	UPT MAC'I
RUN						(LBM/SEC)	(LBM/SEC)	(FI/SEC)	(FI/SEC)	(FI/SEC)	
-	0.0	0.3357	0.8745	0.3858	0.0	0.187	0.0	175.01	58.33	58.33	0.048
2	0.1888	0.2594	0.8745	0.2967	0.1780	0.187	0.035	174.90	67.85	58.30	0.048
'n	0.3507	0.1770	0.8745	0.2024	0.3306	0.187	990*0	174.83	76.05	58.27	0.048
4	0.4829	0.1063	0.8745	0.1215	0.4552	0.187	0.000	174.77	82.79	58.25	0.048
ഗ	9109.0	0.0414	0.8760	0.0473	0.5675	0.187	0.113	174.56	89.83	58.18	0.049
9	0.6275	0.0192	0.8760	0.0220	0.5920	0.169	0.118	174.54	90.15	58.18	0.048
7	0.6248	9600.0	0.8760	0.0110	3.5895	0.158	0.117	174.54	10.06	58.18	0.048
83	0.6274	0.0074	0.8760	0.0094	0.5919	901.0	0.118	174.54	90.15	58.18	0.048
5	0.6555	1900.0	0.8760	0.0076	0.6184	0.188	0.123	174.54	91.58	58.18	0.048
10	****	0.0	0.8760	0.0	***	0.188	****	174.52	****	58.17	0.048

0.0

5.5

Table IX. Continued.

UATA TAKEN 29 JUNE 77 BY PETE HARRELL

ONE NOZZLE, ELLIPTIC TRANSITION, STANDOFF 0.0

1/1/5.57/0/15

2.0 MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10 1.5 0.0 0.0 0.0 X/D: PMS(IN. H20): PMS*:

0.0

0.0 3.5 0.0 0.0

3.0

Single-Nozzle Performance Data for L/D = 5.57, Elliptic Transition. (a) S/D = 0.0, $M_u = 0.082$ Table X.

DATA TAKEN 29 JUNE 77 BY PETE HARRELL

The state of the s

												×.						UPT MACH		0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.067
					911	AREA	CHES)		r.		2	4		8	2	2	*	ΩΩ	(FI/SEC)	82.16	82.11	82.00	81.98	95-10	81.93	81.85	81.85	81.84	81.56
	O INCHES	3.00	2-154 INCHES		29.78 INCHES UG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	****	H _O	(FI/SEC)	82.16	95.70	107.56	118.67	129.15	133.04	133.51	133.58	134.24	***
	m.			A: 0.70		PA-PN2	ER)	4.18	3.54	2 - 46	1-60	99*0	66.0	0.17	0.13	0.11	0.0	UP	(LBM/SEC) (FT/SEC)	246.51	246.35	246.01	245.94	245.90	245.81	245.55	245.55	245.52	244.69
	PIAKE UIAM	ARFA RATIO, AM/AP:	URIFICE DIAMETER:	ORIFICE BETA: 0.70	AMBIENT PRFSSURE:	PA-PS	(INCHES OF WATER)	4.78	3.54	2.46	1.60	99-0	0.33	0.17	0.13	0.11	0.0	WS		0.0	0.050	0.094	0.135	0.173	0.187	0.189	0.189	0.192	*
01/0	ä	¥	ā	ō	₹	PIJ-PA	CINC	4.90	6.10	7.20	8.10	8.90	9.20	05.6	05.6	9.50	09*6	3	(LBM/SEC)	0.264	0.265	0.265	0.265	0.265	0.265	0.265	0.265	0.265	0.266
1/1/5.57/0/10						TAMB	NHE I T)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	74.0	74.0	14.0	55.**I*W		0.0	0.1782	0.3339	0.4784	0-6140	0.6645	0.6714	0.6722	0.6808	****
0.0		ES				1001	(DEGREES FAHRENHEIT)	150.0	151.0	151.0	152.0	153.0	153.0	152.0	152.0	152.0	148.0	p*/1*		0.4065	0.3019	0.2104	0.1371	0.0567	0.0284	0.0146	0.0112	0.0095	0.0
ION, STANOOFF		R: 1.732 INCHES	16.71 INCHES	3.00 INCHE'S		708	(DEG	150.0	151.0	151.0	152.0	153.0	153.0	152.0	152.0	152.0	148.0	<u>*</u>		0.8753	0.8739	0.8739	0.8725	0.8711	0.8711	0.8725	0.8125	0.8725	0.8782
RANS I T ION,	KY NOZZLES	DIAMETER:			į,	OPOR	OF WATER)	10.0	10.0	10.0	10.0	0.01	10.0	10.0	0.01	10.0	10.0	*	•	0.3558	0.2639	0.1839	0.1197	0.0494	0.0247	0.0128	0.0098	0.0083	0.0
ELLIPTIC TE	NUMBER OF PRIMARY NOZZLES:	PRIMARY NOZZLE DIAMETI	MIXING STACK LENGTH;	MIXING STACK DIAMETER:	MIXING STACK L/0:	PGR	CINCHES OF WAT	10.9	12-1	13.2	14-1	14.9	15.2	15.4	15.4	15.5	15.6	*	•	0-0	0.1891	0.3543	0.5080	0.6524	0.7061	0.7129	0.7138	0.7229	****
ONE NOZZLE, ELLIPTIC TRANSITI	NUMBER	PRIMAR	MIXIN	NIXIX	MIXIM	2	2	-	۰	ı m	. 4	Ŋ	. 40	~	- α	6	10	z	: 3	-	۰ ۸	ורח	4	· w	, . c	. ~	. 20	. 0	01

5 2.0 2.5 3.0 3.5 59 -0.44 -0.25 -0.15 .0.01 .04 -0.03 -0.02 -0.01 -0.01 (b) S/D = 0.0, $M_{\rm H} = 0.068$ 1.5 2.0 -0.59 -0.44 -0.04 -0.03 MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10 1.0 0.5 0.0 X/D: PMS(IN. H20):

-0.10

PMS*:

Table X. Continued.

0.0

DATA TAKEN 29 JUNE 77 BY PETE HARRELL

ONE NOZZLE, ELLIPTIC TRANSITION, STANOOFF 0.0

1/1/5.57/0/05

PRIMARY NOZZLE DIAMET MIXING STACK LENGTH;	PRIMÁRY NOZZLE DIAMETER: 1.732 INCHES	1.732 INCH	4 1							
X LE			ES		₹	AREA KATIU, AM/AP:		3.00		
		16.71 INCHES			Ö	ORIFICE DIAMETER:		2.154 INCHES		
CK 01	MIXING STACK DIAMETER: 3	3.00 INCHES			Ē	ORIFICE BETA: 0.70	A: 0.70			
MIXING STACK L/D:	0: 5.57				¥	AMBIENT PRESSURE:		29.78 INCHES HG	HG	
POR	DPOR	10K	1001	TAMB	PU-PA	PA-PS	PA-PNZ	SECONDARY AREA	IREA	
CHES	(INCHES UF WATER!)	(DEG	(DEGREES FAIRENHEIT)	ENHE I T)	CINC	(INCHES OF WATER)	ER)	(SQUARE INCHES)	HES !	
5.5	5.0	149.0	149.0	14.0	2.50	76.5	2.37	0.0		
1.9	5.0	149.0	149.0	74.0	3.00	1.78	1.78	0.785		
2.9	5.0	149.0	149.0	14.0	3.60	1.25	1.25	1.767		
7.1	5.0	149.0	149.0	14.0	4.00	0,78	0.78	3.142	•	
7.5	5.0	149.0	149.0	14.0	4.50	0.32	0.32	6.284		
1.6	5.0	149.0	149.0	14.0	4.60	0.16	91.0	9.621	_	
1.1	5.0	149.0	149.0	74.0	4.70	80.0	0.08	13.548	_	
1-1	5.0	149.0	145.0	14.0	4.70	90.0	90.0	15.512		
7.8	5.0	149.0	149.0	14.0	4.80	90.0	0.05	17.082	•	
7.8	5.0	0.941	146.0	14.0	4.80	0.0	0.0	*****	_	
*	*d	* h	*1/**	55***I*M	۵. ع	S PK	ď	W O	3	UPT MACH
					(LBM/SEC)	(LBM/SEC) (FT/SEC)	(FI/SEC)	(FI/SEC)	(FT/SEC)	
0.0	0.3498	0.8768	0.3990	0.0	181.0	0.0	175.06	58.35	58.35	0.048
0.1856	0.2630	0.8768	0.3000	0.1789	0.187	0.035	174.97	64.79	58.32	0.048
0.3573	0.1850	0.8768	0.2110	6.3373	0.187	190.0	174.85	16.48	58.28	0.048
0.5017	0.1155	0.8768	0.1318	0.4735	0.187	0.094	174.76	83.85	58.25	0.048
0.6373	0.0467	0.8768	0.0533	0.6015	0.187	0.119	174.63	87.05	58.21	0.048
0.6844	0.0230	0.8768	0.0262	0.6459	0.187	0.128	174.61	61.66	58.20	0.048
0.6923	0.0119	0.8768	0.0135	0.6534	0.187	0.130	174.59	93.60	58.19	0.048
9.6865	0.0089	0.8768	0.0102	0.6479	181.0	0.129	174.59	93.30	58.19	0.048
006900	0.0074	0.8758	0.0085	0.6512	0.187	0.129	174.51	93.48	58.19	0.048

MIXING STACK PRESSURE DISTRIBUTION FOR KUN: 10 0.0 0.0 0.0 0.0 X/D: PHS(IN. H20): PMS*:

0.0

DATA TAKEN 8 JULY 77 BY PETE HARRELL

1/1/5.57/-024/15	
-0-24	
STANDUFF	
INE NOZZLE, ELLIPTIC TRANSITION, STANDUFF	
ELLIPTIC	
NOZZLE,	
Ņ	

											UPT MAC-		0.083	6.00	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
S HG	AREA YCHES)		85 57		94	11	8,	21	35	:	3	(FT/SEC)	100.41	100.21	10.001	49.88	69.66	99.66	69.65	99.62	69.66	79*66
3.00 INCHFS 3.00 2.154 INCHES 0 29.84 INCHES HG	SECONDARY AREA (SQUARE INCHES)	0.0	0.785	3.142	6.284	9.621	13.548	15.512	17.082	****	181	(F1/5EC)	100.41	116.98	131.56	144-11	156.85	160.51	162.21	162.09	162.81	****
IFTFR: 3. AM/AP: IMETER: 2 A: 0.70 SSURE: 2	PA-PNZ FR)	7.10	3.76	2.33	0.97	0.48	0.25	0.19	91.0	0.0	a a	(FT/SEC)	301.24	300.64	300.05	299.65	299.10	55.852	298.88	298.88	565.09	298.88
JPTAKE DIAMFTER: 3 AREA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIENT PRESSURE:	PA-PS PA	7.10	5.41	2.33	16.0	0.48	0.25	0.19	91.0	0.0	M.S	(LBM/SEC)	0.0	0.062	0.116	0.163	0.210	0.225	0.230	0.279	0.232	****
5 4 5 5 4	PU-PA (INC)	1.50	9.20	12.00	13.40	13.70	14.00	14.00	14.10	14.10	d #	(LBM/SEC)	0.324	0.324	0.325	0.325	0.326	0.326	0.326	0.326	0.326	0.326
	TAMB NHE IT 1	13.0	73.0	73.0	73.0	73.0	13.0	13.0	73.0	73.0	W* T * * . 44		0.0	0.1795	0.3362	0.4699	0.6054	0.6484	0.6622	0199.0	0.6679	***
ES	TUPI TAH	154.0	154.0	154.0	154.0	154.0	154.0	154.0	155.0	154.0	p*/1*		0.4062	0.3107	0.2168	0.1347	0.0563	0.0276	0.0145	0.0110	0.0093	0.0
ZLES: 1 ER: 1.732 INCHES 16.71 INCHES : 3.00 INCHES	TOR (DEG	154.0	154.0	154.0	154.0	154.0	154.0	154.0	155.0	154.0	*		0.8680	0.8680	0898.0	0.8680	0.8680	0.8600	0.8680	0.8680	9998-0	0.8680
RY NOZZLES DIAMETER: NGTH: 16.7 AMETER: 3	POR DPOR	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	*a		0.3526	0.2697	0.1882	0-1169	0.0489	0.0239	0.0126	9600.0	0. 0081	0.0
NUMBER OF PRIMARY NOZZLES: PRIMARY NUZZLE DIAMETER: 1. MIXING STACK LENGTH: 16.71 MIXING STACK DIAMETER: 3.C	POR (INCHES	16.4	19.8	21-1	22.4	22.7	23.0	23.0	23.1	23.2	*		0.0	0.1910	0.3578	1005-0	0.6443	0.6901	0.1047	0.7034	6.1113	**
NUMB PRIM MIXI MIXI	s S S		01 m	4	S	9	7	89	6	10	z	RUN		2	m	4	ď	9	7	80	6	01

		2016	211		NOT WOL	2					
	:C/X	0.0	0.5	0.1	1.5	2.0		3.0	3.5	0.4	
PMS(IN.	1120):	0-0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	
PMS+: 0.0 0.0 0.0 0.0 0.0	PHS *:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
					7	0/0	680 0= W VC 0 - 0/3 (F)	2	=0.082		

(d) S/D = -0.24, $M_u = 0.082$ Table X. Continued.

DATA TAKEN 8 JULY 77 BY PETE HARRELL

ONE NOZZLE, ELLIPTIC TRANSITION, STANOOFF -0.24

01/520-/15.5/1/1

																	UPT YACH	•	0.048	0.068	0.068	0.068	0.067	0.067	0.067	0.067	0.067	0.067
				116	AREA	CHES		ιΛ		, ~		-	c	۸.	~		20	(F 1/SEC)	82.29	81.58	82.06	81.48	81.89	81.67	81.85	81.86	81.17	81.56
3.00 INCHES	3.00	2.154 INCHES		29.84 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	*****	¥	(FT/SEC)	82.29	95.36	107.42	118.17	128.30	131.34	133.45	133.53	134.13	****
		HETER: 2	A: 0.70		PA-PN2	FR.)	4.68	3.34	2.43	1.56	99.0	0.31	0.17	0.13	0.11	0.0	91	Ξ	246.90	546.56	246.20	245.96	245.69	245.63	245.57	245.59	245.33	244.10
UPTAKF DIAMETER:	AREA RATIO, AM/AP:	ORIFICE DIAMETER:	ORIFICE BETA: 0.70	AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	4.68	3.54	2.43	1.56	99.0	0.31	0.17	0.13	0.11	0.0	ý	(LBH/SEC)	0.0	0.049	0.093	0.133	0.170	0.182	0.189	0.100	0.192	******
å	AK	CIR	OR	Ā	PU-PA	LINCH	06*5	00.9	7.10	1.50	8.80	9.00	9.20	9.20	9.30	04.6		()		0.264	0.265	0.265	0.205	0.265	0.265	0.265	0.266	0.266
					TAMB	HELT)	74.0	74.0	74.0	14.0	74.0	74.0	74.0	0.47	14.0	74.0	77 *****		0.0	0.1731	0.3320	0.4726	0.6047	0.6442	0.6716	0.6724	0.6810	*******
	S.				TUPT	(DEGREES FAHRENHELT)	153.0	153.0	153.0	153.0	153.0	153.0	153.0	153.0	152.0	149.0	**/**		0.3979	0.3018	0.2078	0.1337	0.0550	0.0266	9510.0	0.0112	9600.0	0.0
	ER: 1.732 INCHES	16.71 INCHES	3.00 INCHES		10k	(DEGR	153.0	153.0	153.0	153.0	153.0	153.0	153.0	153.0	152.0	149.0	:	<u>.</u>	0.8711	0.8711	0.8711	0.8711	0.871!	0.8711	0.8711	0.8711	0.8725	0.8768
Y M022LES:	IAMETER: 1	GTH: 16.71	••	iĢ	OPOR	UF WATER)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	é	Ž	0.3466	0.2629	0.1810	0.1164	0. C479	0.0232	0.0127	0.0097	0.0083	0.0
NIMBER OF PRIMARY NOZZLES:	PRIMARY NOZZLE CIAMET	MIXING STACK LENGTH:	MIXING STACK DIAMETER	MIXING STACK L/D:	POR	ES	11.0	12.1	13.1	13.9	14.8	15.0	15.2	15.3	15.3	15.4	:	ż	0.0	0.1840	0.3528	0.5022	0.6426	0.6845	0.7137	0.7145	0.7231	****
MIN	PRIMA	MIXIM	MIXIM	MIXIM	z	en.	_	2	м	4	\$	9	2	&	5	01	:	z =	į -	. 2	m	. 4	4	9	~	80	6	01

0.75 0.57 0.42 0.20 0.13 0.06 -0.04 -0.03 -0.07 0.01 $(e) S/D = -0.24, M_{H} = 0.068$ MIXING STACK PRESSURE DISTRIBUTION FOR RUN: '10 90.0-1.0 -1.23 9.0 -1.34 PHS(1N. H20):

-0.10

Table X. Continued.

0.0

HARRELL
PETE
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17
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	UPTAKE DIAMETER: 3.00 INCHES AREA RATIO, AM/AP: 3.00 ORIFICE DIAMETER: 2.154 INCHES ORIFICE BETA: 0.70 AMBIENT PRESSURE: 29.84 INCHES HG
1/1/5.57/-024/05	
ONE HOZZLE, ELLIPTIC TRANSITION, STANOOFF -0.24	NUMBER OF PRIMARY NOZZLES: 1 PRIMARY NUZZLE DIAMETER: 1.732 INCHES MIXING STACK LENGTH; 16.71 INCHES MIXING STACK DIAMETER: 3.00 INCHES MIXING STACK 1./0: 5.57

	0.048 0.048 0.048 0.048 0.048 0.048 0.048
AREA AREA 35 35 37 37 38 38 38 38	6 F 1/SEC) 58.31 58.26 58.20 58.16 58.16 58.14 58.15 58.15
SECONDARY AREA (SQUARE INCHES) 0.0 0.785 1.767 3.142 6.284 9.621 13.548 15.512 17.082	UM (FT/SFC) 58.31 67.89 76.24 83.49 90.91 93.62 95.62 94.61
. 32 . 79 . 73 . 52 . 52 . 52 . 95 . 05	UP 174.93 174.93 174.80 174.69 174.60 174.48 174.43 174.43
PA-PS PA 2.32 2 1.75 1 1.23 1 0.77 0 0.32 0 0.16 0 0.09 0 0.09 0 0.05 0	NS (LBM/SEC) 0.0 0.056 0.056 0.067 0.067 0.093 0.121 0.138 0.134 0.138
61N 2-40 3-00 3-50 3-90 4-40 4-60 4-60 4-60 4-60	HP (LBM/SEC) 0-187 0-187 0-187 0-188 0-188 0-188 0-188
TAMB 73.0 73.0 73.0 73.0 73.0 73.0 73.0 73.0	0.0 0.1194 0.3346 0.4690 0.6064 0.6563 0.6932 0.6934
TUPT TAM (DEGREES FAHRENHEIT) 0 149.0 73.0 13.0 149.0 73.0 149.0 73.0 149.0 73.0 149.0 73.0 149.0 73.0 149.0 73.0 149.0 73.0 73.0 149.0 73.0 73.0 149.0 73.0	0.3904 0.3904 0.3016 0.2075 0.1252 0.0541 0.0271 0.0110
10R 149.0 149.0 149.0 149.0 149.0 149.0 149.0	0.8751 0.8751 0.8751 0.8751 0.8751 0.8751 0.8751 0.8751
(INCHES OF WATER) 5.5 5.0 6.1 6.1 5.0 149.0 6.6 5.0 149.0 7.0 5.0 149.0 7.6 5.0 149.0 7.6 5.0 149.0 7.7 5.0 149.0 7.7 5.0 149.0 7.7 5.0 149.0	0.3416 0.2640 0.1816 0.1131 0.0474 0.0237 0.0036 0.0074
POR (INCHES 5.5 6.1 6.6 7.0 7.6 7.7 7.7	0.0 0.1903 0.3549 0.4914 0.6914 0.7351 0.7351
N 1 2 4 4 4 4 4 6 6 0 0 0 0 0 0 0 0 0 0 0 0 0	N 1 2 4 2 2 2 2 3

0.0

DATA TAKEN 28 JUNE 77 BY PETF HARRELL

																UFT NAC+		0.083	0.083	0.083	0.082	0.082	0.082	0.082	0.082	0.082	0.082
		•	9 #	AREA	ICHE S.)		5		,	4	-	89	2	Ž.	*	an	(FT/SEC)	100,40	100.12	62.06	26.66	16-66	99.88	39.65	89.65	12.65	74.66
	3.00 INCHES 3.00 2.154 INCHES		29.85 INCHES HG	SECUNDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	15.548	15.512	17.082	*****	W	(FI/SEC)	100.40	116.52	130.03	141.48	151.29	154.46	155.44	154.96	154.20	*****
		TA: 0.70		PA-PNZ	rer)	7.00	5.20	3.47	2.07	0.79	0.38	0.20	0.15	0.12	0.0	п	(F1/SEC)	301.22	300-39	299.38	299.18	299.73	299.66	298.89	68.895	299.14	298-33
	IPPTAKE DIAMETER: 3 AREA RATIO, AM/AP: ORIFICE DIAMETER:	ORIFICE BETA: 0.70	AMBIENI PRESSURE:	PA-PS	(INCHES OF WATER)	7.00	5.20	3.47	2.07	0.79	0.38	02.0	0.15	0.12	0.0	MS	(LBM/SEC) (LBM/SEC) (FT/SEC)	0.0	0.061	0.112	0.154	0.190	0.202	0.206	0.204	0.201	******
-084/15			•	PIJ-PA) (144	1.50	01.6	10.50	11.40	12.20	12.40	12.50	12.50	12.50	12.70	M.	(LBM/SEC	0.324	0.325	0.326	0.325	0.325	0.325	0.326	0.326	0.326	0.327
1/1/5.57/-084/15				TAMB	ENHEITI	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	44.1+W		0.0	0.1760	0.3231	0.4433	0.5473	0.5810	0.5933	0.5883	0.5795	******
-0-84	lf S			TUPT	(DEGREES FAHRENHEIT)	154.0	153.0	151.0	154.0	155.0	155.0	152.0	152.0	153.0	150.0	\$1/*d		0.4004	0.2986	0.1999	0.1195	0.0457	0.0220	0.0116	0.0087	6900.0	0.0
TIUN, STANDOFF	12LES: 1 TER: 1.732 INCHES 16.71 INCHES	R: 3.00 INCHES		TOR) JUE	154.0	153.0	151.0	154.0	155.0	155.0	152.0	152.0	153.0	150.0	÷		0.8647	0.8662	0.8690	0.8647	0.8633	0.8633	0.8676	0.8676	0.8662	0.8704
FRANSITION,		ETE	75.57	DPOR	OF WATER!	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	g. *		0.3462	0.2586	0.1737	0.1034	0.0395	0.6190	0.0100	0.0075	0900 0	0.0
ELLIPTIC	NUMBER OF PRIMARY NO: PRIMARY NOZZLE DIAME! MIXING STACK LENGTH;	HIXING STACK DIAMETER	MIXING STACK L/0:	POR	CINCHES OF WAT	16.5	18.1	19.5	20.4	21.2	51.4	21.5	21.5	21.5	21.7	*		0.0	0.1675	0.3437	0.4726	0.5839	0.6198	0.6316	0.6263	0.6174	******
ONE NOZZLE, ELLIPTIC TRANSII	NUMB PRIM MIXIR	HIXIM	MIXIX	z	RUN	~	2	m	4	ĸ	•	1	80	6	10	z	KUN	-	~	е	4	iv.	9	7	83	6	01

HIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

X/0: 0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5

PHS(IN. H20): 0.0 0.0 0.0 0.0 0.0 0.0 0.0

PHS*: 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

(g) S/D = -0.84, M_u =0.082

Table X. Continued.

0.0

DATA TAKEN 28 JUNE . 77 BY PETE HARRELL

1/1/5.57/-084/10
-0.84 1/1
STANDUFF
TRANSITION,
E, ELLIPIIC
ONE NOZZLE,

			UPT HACH	0.068	890°0 890°0	0.068 840.0
S HG	AREA NCHES) 85			67./SEC 82.19 82.17	81.81	81.75
UPTAKE DIAMETER: 3.00 INCHES AREA RATIO, AM/AP: 3.00 DRIFICE DIAMETER: 2.154 INCHES OKIFICE BETA: 0.70 AMBIENT PRESSURE: 29.85 INCHES HG	SECONDARY AREA (SQUARE INCHES) 0.0	1.767 3.142 6.284 9.621 13.548	17.082 ********	(FT/SEC) 82.19 95.58	115.76	126.74 [26.94 126.24
R: 3 /AP: ER: 0.70	PA-PN2 IER) 4-60	2.28 1.38 0.53 0.25 0.13		(FT/SEC) 246.59 246.52 246.22	245.43	245.22
UPTAKE DIAMETER: 3.00 I AREA RATIO, AM/AP: 3.00 DRIFICE DIAMETER: 2.154 OKIFICE BETA: 0.70 AMBIENT PRESSURE: 29.85	PA-PS PA IINCHES OF WATER)	2.28 1.58 0.53 0.25 0.15		(LBM/SEC) 0.0 0.050	0.125	0.166
	FU-PA (INC 5.00	6.90 7.50 8.20 8.20	8.30 8.40 W	(LBM/SEC) 0.264 0.264	0.256	0.266
	TAMB NHE I T 1 72.0 72.0	72.0 72.0 72.0 72.0 72.0	72.0 72.0 W*T**.44	0.0	0.4446	0.5880
E S	TUPT TAN (DEGREES FAHKENHEIT) 0 152.0 72.	153.0 150.0 150.0 150.0 150.0	150.0 145.0 P#/T#	0.3913	0.1181	0.0086
1022LES: 1 HETER: 1.732 INCH I; 16.71 INCHES ER: 3.00 INCHES 5.57	TOR (DEG 152.0	153.0 150.0 150.0 150.0 150.0	150.0 145.0 1*	0.8692	0.8721	0.8721 0.8721 0.8721
2 4 4 5 E	POR DPOR 11ACHES OF WATER) 11.0 10.0	0.01	10.0 10.0 P*	0.2575	0.1030	0.0015
NUMBER OF PRIMARY N PRIMARY NOZZLE DIAM MIXING STACK LFNGTH MIXING STACK DIAMET	POR (1ACHES 11.0	12.5	14°9	0.0	0.5849	0.6245
NUMBE PRIMA MIXIN MIXIN	RUN 2 4	(ま す ら ひ ト の)	6 0 z	RUN 2 2 1 8	ነ ተ ጥ ፈ	o ~ a ~ .

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

_		0
4.0	-0.07	00.0-
3.5	-0.20	-0.01
3.0	-0.34	-0.03
2.5	-0.55	·0·0·
2.0	-0.17	-0.06
1.5	-0.94	10.0.
1.0	-1.03	.0.08
6.5	-1.18	-0-09
0.0	-1.32	-0.10
:0/x	11501:	PMS*:
	PMS(IN.	

(h) S/D = -0.84, $M_u = 0.068$ Table X. Continued.

DATA TAKEN 29 JUNE 77 BY PETE HARRELL

1/1/5.57/-084/05
-0.84
STANDOFF
ELLIPTIC TRANSITION,
ELL 1P 11C
ONE NOZZLE,

										١							UPT MAC4		0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
				HG	REA	HES)							_				3	·(F1/SEC)	58.43	58.39	58.35	58.33	58.32	58.26	·58.26	58.26	58.27	57.88
3.00 INCHES	3.00	2.154 INCHES		29.85 INCHES HG	SECUNDARY AREA	I SQUARE INCHES)	0.0	0.785	1.767	5-145	6.284	5.621	13.548	15.512	17,082	***	¥,	(FI/SEC)	58.43	67.77	15.87	82.29	97.78	89.54	91.22	61.19	91.59	****
			1: 0.70		PA-PNZ	:R)	2.27	11.11	1.17	69.0	0.26	61.0	0.07	0.05	0.04	0.0	ð	(FI/SEC)	175.29	175.18	175.07	10.21	174.96	174.80	174.80	174.80	174.82	173.65
UPTAKE DIAMETER:	AREA RATIO, AM/AP:	ORIFICE DIAMETER:	ORIFICE BETA:	AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	2.27	1.71	1.17	69*0	0.26	0.13	10.0	90.0	0.04	0.0	N.S	(I.BH/SEC)	0.0	0.035	990.0	0.089	0.109	0.116	0.122	0.124	0.123	*****
ďſ	AK	OR	OR	AA	PU-PA	(INCH	2.50	3.00	3.50	3.80	4.00	4.10	4.10	4.10	01.4	4.20	a a	(LBM/SEC)	0.187	0.187	0.137	0.187	0.187	0.187	0.187	0.187	0.187	0.189
				•	TAMB	HE1T)	72.0	72.0	72.0	12.0	12.0	72.0	72.0	72.0	72.0	72.0	74.4*I*W		0.0	0.1755	0.3265	0.4457	0.5471	0.5807	0.6119	0.6210	0.6185	******
	1 0				1001	(DEGREES FAIRENIETT)	152.0	152.0	152.0	152.0	152.0	151.0	151.0	151.0	151.0	143.0	P*/T\$		0. 3822	0.2882	0.1975	0.1165	0.0439	0.0211	0.0118	0.0053	0.0076	• 0.0
	732 INCHE	16.71 INCHES	O INCHES		T0R	IDEGR	152.0	152.0	152.0	152.0	152.0	151.0	151.0	151.0	151.0	143.0	*		0.8692	0.8692	0.8692	0.8692	0.8692	0.8706	0.8706	0.8706	0.8705	0.8822
NOZZLES:	AMETER: 1.	TH: 16.71	ETER: 3.0	5.57	DPOR	GF WATER)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	*		0.3322	0.2505	0.1716	0.1013	0.0382	0.0184	0.0103	0.0081	9900 0	0.0
NUPBER OF PRIMARY NOZZLES:	PRIMARY NOZZLE DIAMETER: 1.732 INCHES	MIXING STACK LENGTH:	MIXING STACK DIAMETER: 3.00 INCHES	MIXING STACK L/D: 5.57	PUR	ES	5.5	0.9	6.5	9.9	7.0	7.1	7.1	7.1	7.2	7.3	*		0.0	0.1866	0.3473	0.4741	0.5819	0.6172	0.6503	0.6600	0.6574	****
NUPBER	PRIMARY	MIXING	MIXING	MIXING	z	RUN	-	8	m	4	S	9	7	80	6	10	z	RUN		8	m	4	v	٥	~	80	•	10 **

0.0 MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10 0.0 0.0 0.0 0.0 PMS(IN. H20):

(i) S/D = -0.84, $M_{u} = 0.048$ Table X. Continued.

0.0

3.0



													_	_										
	9	AREA ICHES)		2	2.	2	51	=	æ	2	21	*	n n	(F1/SEC)	100.43	100.28	100.06	06.55	99.75	99.78	99.16	98.16	\$0.15	69.65
	3.00 INCHES 3.00 2.154 INCHES 0	SECONDARY AREA (SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	*****	¥	(FT/SEC)	100.43	116.92	131.43	143.85	156.44	160.84	142.47	162.36	163.01	*****
	HETER: 3. AM/AP: AMETER: TA: 0.70	PA-PNZ [ER]	7.16	5.30	3.70	2.29	0.95	0.47	0.25	0.19	0.16	0.0	ð	(FT/SEC)	301.31	300.85	300.19	11:662	299.27	259.37	299.30	299.30	299.26	16.862
	UPTAKE DIAMETER: 3 AKEA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIENT PRESSURE:	PA-PS PA	7.16	5.30	3.70	5.29	96*0	14.0	0.25	0.19	91.0	0.0	S M	(LBM/SEC)	0.0	190.0	0.115	0.161	0.207	0.223	0.229	0.229	0.231	*****
21/15	5 4 0 0 4	PU-PA	1.40	9.30	11.00	12-30	13.60	14.00	14.20	14.20	14.30	14.50	ď	(LBM/SEC)	0.324	0.324	0.325	0.325	0.326	0.326	0.326	0.326	0.326	0.326
1/1/4.57/0/15		TAMB NHEIT)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	55° 4 # 1 + M		0.0	0.1776	0.3334	0.4657	0.5989	2559-0	0.6620	0.6608	0.6677	****
0.0	FIS S	TUPT TAM (DEGREES FAHRENHEIT)	154.0	155.0	155.0	155.0	155.0	156.0	156.0	156.0	156.0	155.0	p*/1*		9604.0	0.3045	0.2135	0.1326	0.0552	0.0273	0.0145	0.0110	6600.0	0.0
STANDOFF	1.732 INCH 1.732 INCH 71 INCHES 3.00 INCHES	TOR (DEGI	154.0	155.0	155.0	155.0	155.0	156.0	156.0	156.0	156.0	155.0	*		0.8713	0.8698	0.8698	0.8698	0.8698	0.8684	0.8684	0.8684	0.8684	0.8698
C TRANSITION, STANDOFF	LE DIAMETER: 1.732 INCHES LENGTH: 13.71 INCHES DIAMETER: 3.00 INCHES L/D: 4.57	OPOR ES OF WATER)	15.0	15.0	15.0	15.0	15.0	0.21	15.0	15.0	15.0	15.0	* d		0.3567	0.2648	0.1857	0.1153	0.0480	0.0237	0.0126	9600*0	0.0081	0.0
	NUMBER OF PRIMARY NOZZLES: PRIMARY NOZZLE DIAMETER: 1 MIXING STACK LFNGTH: 13.71 MIXING STACK DIAMETER: 3. MIXING STACK L/D: 4.57	POR (INCHES (16.4	18.3	19.9	21.2	22.6	23.0	23.2	23.2	23.3	23.4	ž		0.0	0.1389	0.3545	0.4952	0.6368	0.6860	0.7044	0.7031	0.7104	****
ONE NOZZLE, ELLIPTI	NUMBE PRIMA MIXIN MIXIN	A PUN	7	7	m	4	ທ	•	1	9 0	6	10	z	RUN		7	3	4	٧.	9	1	80	6	01

0.083 0.083 0.082 0.082

0.082 0.082 0.082

0.082

MIXING STACK PRESSURE DISTRIBUTION FOR KUN: 10 0.0 0.0 0.0 0.0 PHS(1N. H20): PMS 4:

(a) S/D = 0.0, $M_u = 0.082$

3.0

Table XI. Single-Nozzle Performance Data for L/D = 4.57, Elliptic Transition

DATA TAKEN 8 JULY 77 BY PETE HARRELL

€ -

ONF NOZZLE, ELLIPTIC TRANSITION, STANDDFF 0.0

1/1/4-57/0/10

								•					UPT MAC 1		0.069	0.048	0.00.0	0.068	0.067	0.067	0.067	0.067	190.0	0.067
9	AREA	CHESI		2	~	~	•	-	.	~	~	•	20	(FT/SEC)	82.35	82.23	82.12	82.03	82.01	81.98	82.03	82.04	R2.02	81.42
3.00 fuches 3.00 2.154 inches 0 29.84 inches hG	SECUNDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	• • • • • • • • •	¥	(F1/SFC)	82.35	95.17	107.29	117.50	128.10	131.50	133.66	133.73	134.39	•
~ .	PA-PNZ	ER)	4.75	3.52	2.39	1.53	69.0	0.31	21.0	0.13	0.11	0.0	d5	(FT/SEC)	247.07	246.70	246.37	246.10	246.06	245.96	246.11	246.13	246.08	244.27
UPTAKE DIAMETFR: 3 AREA RATIO, AM/AP: Ukifice Diameter: Orifice Beta: 0.70 Ambient pressure:	PA-PS	(INCHES OF WATER)	4.75	3.52	2.39	1.53	69.0	0.31	21.0	0.13	0.11	0.0	A S	(LBM/SEC)	0.0	0.050	0.003	0.132	0.169	0.181	0.189	0.189	0.192	****
# # 5 5 4	PII-PA	CINC	4.90	6.10	7.20	9.10	00.6	9.30	04.5	9.40	9.50	9.50	3	(LBM/SEC)	0.264	0.264	0.265	0.265	0.265	0.265	0.265	0.265	0.265	0.267
	1 AMB	WIE LT)	75.0	75.0	15.0	75.0	75.0	75.0	75.0	75.0	75.0	15.0	55***1*M		0.0	1111.0	0.3292	0.4679	0.5998	0.6439	0.6716	0.6723	0.6810	******
S	TUPT	(DEGREES FAHRENHEIT)	154.0	154.0	154.0	154.0	155.0	155.0	156.0	156.0	156.0	147.0	P*/T*		0.4040	2005 -0	0.2044	0.1311	0.0541	0.0266	0.0146	0.0112	0.0095	0.0
2LES: 1 ER: 1.732 INCIII 13.71 INCIIES :: 3.00 INCIIES	10R	(066	154.0	154.0	154.0	154.0	155.0	155.0	156.0	156.0	156.0	147.0	*		0.8713	0.8713	0.8713	0.8715	8678.0	0.8698	0.8684	0.868	0.0684	0.8813
Y NOZZLES: HAMETER: 1 GTH; 13.71 METER: 3.	OPOR	F WATER!	10.0	10.0	10.0	10.0	10.0	0.01	10.0	10.0	10.0	10.0	* d		0.3520	0.2616	0.1781	0.1143	0.0471	0.0232	0.0127	0.0097	0.0082	0.0
NUMBER OF PRIMARY NUZZLES: 1 PRIMARY NUZZLE DIAMETER: 1.732 INCHES MIXING STACK LENGTH; 13.71 INCHES MIXING STACK DIAMETER: 3.00 INCHES MIXING STACK LDAMETER: 3.00 INCHES	POR	(INCHES OF WAT	10.9	12.1	13.2	14.1	15.1	15.4	15.4	15.5	15.5	15.5	*		٥•٥	0.1888	0.3498	0.4971	0.6378	0.6847	0.7146	0.7154	0.7247	****
NUMB PRIF MIXI MIXI	z	RUN	-	~	m	4	v	9	7	80	ņ	10	z	RUN		2	ю	4	w	٥		80	6	10

> 0.37 .0.26 MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10 0.52 1.5 -0.63 1.0 -1.09 .1.26 0.0 x/0: PMS(1N. H20):

-0.05

-0.10

PMS .:

(b) S/D = 0.0, $M_u = 0.068$

10.0 10.0Table XI. Continued.

0.048 0.048 0.048 0.048 0.048 0.048
11G AREA CHES) 12 52 12 12 13 148 148 148 148 157/5EC) 58.63 58.20 58.20 58.20 58.20 58.20 58.20
3.00 INCHES 1. 3.00 2.154 INCHES 116 29.84 INCHES 116 29.84 INCHES 116 12 SECUNDARY AREA 15 SECUNDARY AREA 1
Aq. (11) -50 -10 -10 -10 -10 -10 -10 -10 -10 -10 -1
517/0/ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
100 TUP 1 153.0 150.0
INRRELL 15. STANDUFF D 15. 1 16. 1.732 INCHES 3.00 INCHES 3.00 INCHES 3.00 INCHES 150.0 151.0 151.0 151.0 151.0 150.0 150.0 150.0 150.0 151.0 151.0 150.0 150.0 150.0 150.0 150.0 150.0 150.0 151.0 151.0 151.0 151.0 151.0 150.0 150.0 150.0 151.0
PETE HARRE NS1T1UN, ST NU2ZLES: AMETER: 1- TH: 13-T1 EETER: 3.0 4.57 DPUR HATERI 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 6.0 5.0 0.3472 0.2602 0.1791 0.1134 0.0560 0.00230 0.00022
KEN 9 JULY 77 BY PETE HARRELL 21E, ELLIPTIC THANSITION, STANDUFF 0. NUMBER OF PRIMARY NUZZLES: 1 PRIMARY NOZZLE DIAHETER: 1-772 INCHES HIXING STACK L/D: 4-57 HIXING STACK L/D: 4-57 POR DPOR 150.0 6.1 5.0 150.0 7.2 5.0 150.0 7.2 5.0 150.0 7.4 5.0 150.0 7.6 5.0 150.0 7.7 5.0 150.0 7.8 5.0 150.0 7.8 5.0 150.0 7.9 7.0 150.0 7.9 7.0 150.0 7.9 7.0 150.0 7.9 0.0072 0.08770 8 0.6976 0.0074 0.8755 9 0.6976 9 0.6976 0.0074 0.8751 10 **********************************
DATA TAKEN 9 JULY 77 BY PETE HARRELL UNE NOZZLE, ELLIPTIC TRANSITION, STANDOFF NUHBER OF PRIHARY NUZZLES: 1 PRIHARY NOZZLE DIAMETER: 1-772 INC MIXING STACK CLANGTH: 13-71 INCHES MIXING STACK LLNUTH: 13-71 INCHES N POR DPUK TOR S.5 5.0 ISO.0 7.2 5.0 ISO.0 7.4 5.0 150.0 7.6 5.0 150.0 7.7 5.0 150.0 7.8 5.0 150.0 7.8 5.0 150.0 7.8 5.0 150.0 7.8 5.0 150.0 7.9 5.0 150.0 7.9 0.03516 0.1791 0.877 7 0.6321 0.0660 0.877 7 0.6321 0.0650 0.877 7 0.6976 0.0072 0.0877 8 0.6976 0.0074 0.877 9 0.6976 0.0074 0.877 9 0.6976 0.0074 0.877
UNE N

HIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

X/D: 0.0 0.5 1.0 1.5 2.0

IN. H201: 0.0 0.0 0.0 0.0 0.0

PMS*: 0.0 0.0 0.0 0.0 0.0

X/D: PMS(IN. H2U): PMS*:

24.54.75

Table XI. Continued.

ITA TAKEN B JULY 77 BY PETE HARRELL

1/11/4-57/-024/15
-0.24
STANDOFF
: TRANSITION,
ELL IPTIC
ONE NOZZLE,

														UPT MACH		0.083	0.083	0.082	0.082	0.082	0.082	0.082	0.082	0.062	0.082
9 10	AREA	ICHES)		52	~	~	•	-	æ	2	Ŋ	•		3	(F1/SEC)	100.15	100.44	100.15	1 00 00	99.79	66.73	99.72	99.70	12.66	29.66
3.00 INCHES 3.00 2.154 INCHES 0 29.84 INCHES HG	SECONDARY AKEA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	. 9.621	13.548	15.512	17.082	*******	•	ž	(F1/SFC)	100.75	116.91	131.04	143.16	155.26	155.47	161.16	160.63	160.91	0 4 4 5
m _ 2	PA-PN2	WATER	7.10	5.20	3.59	2.21	0.91	0.45	0.24	0.18	0.15	0.0		ā	(F1/SEC)	302.25	301.34	300.47	\$0.006	299.38	259.20	299.16	299.13	299.16	298.88
UPTAKE DIAMETER: 3 AREA RATIO, AM/AP: DAIFICE DIAMETER: GRIFICE HETA: 0.70 AMBIENT PRESSURE:	PA-PS	CINCAES OF WA	7.10	5.20	3.59	12.5	0.91	0.45	0.24	0.18	0.15	0.0		MS	(LOM/SEC)	0.0	0.061	0.113	0.158	0.203	0.219	0.225	0.223	0.224	****
,	V d- fid	0810	1.50	9.30	11.00	12.20	13.40	13.80	13.90	14.00	14.00	14.10		į	(LBM/SEC)	0.323	0.324	0.325	0.325	0.326	0.326	0.326	0.326	0.326	0.376
	TAMB	NHE IT)	15.0	75.0	15.0	15.0	15.0	75.0	15.0	15.0	15.0	15.0		H+T++.44		0.0	0.1760	0.3284	0.4575	0.5863	0.6310	0.6488	0.6433	9959.0	*****
S	TUPT	(DEGREES FAHRENHEIT)	158.0	157.0	156.0	156.0	155.0	155.0	155.0	155.0	155.0	154.0		P0/14		0.4061	0.2987	0.2071	0.1279	0.0528	0.0261	0.0139	0.0105	0.0097	0.0
22LES: 1 ER: 1.732 INCHES 13.71 INCHES I: 3.00 INCHES	10%	10EG	158.0	157.0	156.0	156.0	155.0	155.0	155.0	155.0	155.0	154.0		¢.		0.8656	0.8670	0.8684	0.8684	0.8698	0.8698	0.8698	8698.0	8698.0	0.8713
RY NUZZLES: DIAMETER: 1 NGTH: 13.71 AMETER: 3.0	DPOR	OF WATER!	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0		*		0.3515	0.2590	5611.0	0.1110	0.0459	0.0227	0.0121	0.0091	0.0076	0.0
NUMBER OF PRIMARY NOZZLI PRIMARY NOZZLE DIAMETER MIXING STACK LENGTH: 13. MIXING STACK DIAMETER: MIXING STACK L/D: 4.5:	PUR	(INCHES OF WAT	16.5	18.3	20.0	21.2	22.5	22.8	22.9	23.0	23.1	23.2		*		0.0	0.1874	0.3494	0.4868	0.6233	0.6709	0.6898	0.6840	0.6875	*****
NUMBE PRIHA MIXIN MIXIN	z	RUN	~	8	m	4	ហ	9	1	8	6	01		z	RUN	-	~	M	4	ស	9	~	6 0	6	01

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

X/D: 0.0 0.5 1.0 1.5 2.0 2.

PMS(IN. H2O): 0.0 0.0 0.0 0.0 0.0 0.0 0.0

PMS*: 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

S/D = -0.24, $M_{II} = 0.082$

Table XI. Continued.

DATA TAKEN 8 JULY 77 BY PETE HARRELL

ONE NOZZLE, ELLIPTIC TRANSITION, STANDOFF -0.24

1/1/4.57/-024/10

												UPT MACH		0.068	0°04	890°0	0. nè8	190.0	190.0	190.0	6.06.7	0.067	0.067
9	AREA		ž	۲.	Ŋ	•	_	0	~:	~	•	3	(FT/SEC)	82.28	82.17	82.05	82.05	91.96	81.53	16.18	81.91	81.98	81.84
3.00 INCHES 3.00 2.154 INCHES 0 29.84 INCHES HG	SECUNDARY AREA	0.0	0.785	1.767	3.142	4.284	9.621	13.540	15.512	17.082	******	M	(F1/SEC)	82.28	95.40	107.02	117.33	127.31	130.64	130.42	131.59	131.85	***
HETER! 3. AM/AP! AMETER: 2 A. 0.70 SSURE: 2	PA-PN2	4.66	3.46	2.35	1.48	19.0	0.30	0.15	0.12	01.0	0.0	ų	(LBM/SEC) (FI/SEC)	246.87	246.53	246.17	246.16	245.89	245.19	245.74	245.74	245.74	245.53
UPTAKE DIAMETER: 3 AREA RATIO, AM/AP: URIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIENT PRESSURE:	PA-PS PA	4.66	3.46	2.35	1.48	0.61	0.30	91.0	0.12	01.0	0.0	M.S		0.0	0.049	0.092	621.0	0.166	0.170	0.178	0.182	0.183	*****
5 2 5 6 2	PU-PA	06.4	6.10	7.20	8.00	08.80	9.20	9.30	9.30	9.30	05.6	AP	(LOM/SEC)	0.264	0.264	0.265	0.265	0.265	0.265	0.265	0.265	0.265	0.255
	TAMB	75.0	75.0	15.0	15.0	15.0	75.0	15.0	15.0	75.0	75.0	W#1 ## . 44		0.0	0.1762	0.3264	0.4602	0.5904	0.6335	0.6308	0.6460	0.6494	****
S	TUPT TAM	153.0	153.0	153.0	154.0	154.0	154.0	154.0	154.0	154.0	153.0	, *1/*d		0.3963	0.2951	0.2010	0.1268	0.0524	0.0258	0.0129	0.0103	0.0086	0.0
2LES: 1 ER: 1.732 INCHES 15.71 INCHES : 3.00 INCHES	10K	153.0	153.0	153.0	154.0	154.0	154.0	154.0	154.0	154.0	153.0	*		0.8727	0.8727	0.8121	0.8713	0.8713	0.8713	0.8713	0.8713	0.8713	0.8727
Y NGZZLES: ILAMETER: 1. IGTH: 13.71 METER: 3.0	POR OPUR	10.0	10.0	0.01	10.0	10.0	10.0	0.01	10.0	10.0	10.0	* å.		0.3458	0.2575	0.1754	0.1105	0.0455	0.0225	0.0112	0.000	0.0075	0.0
PRIMARY NOZZLE DIAMETHIXING STACK LENGTH: MIXING STACK LIAMETER MIXING STACK L/D: 4	POR	10.9	12.2	13.2	14.1	14.8	15.3	15.3	15.3	15.3	15.5	ž		0.0	0.1870	0.3466	0.4889	0.6273	0.6731	0.6702	0.6864	0069*0	******
NUMBER PRIMARY HIXING HIXING HIXING	_ 3	2		_									z										*

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

NAME TO THE STATE OF S

DATA TAKEN 8 JULY 77 BY PETE HARRELL

	-																	UPT MACH		0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
					HG SH	AREA	CHES)		S.		2	4		6	~	2	*	3	(F1/SEC)	58.30	58.25	58.22	58.24	58.21	58.19	58.20	58.20	58.20	58.24
	3.00 INCHES	3.00	2.154 INCHES		29.84 INCHES HG	SECUNDARY AREA	(SQUARE INCHES)	0.0	0. 785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	****	ĭ	(FT/SEC)	58.30	67.11	76.13	83.17	69.68	92.03	93.60	93.30	63.45	5 # 5 # # 4 4 # 4 # 4
	FTER: 3.0			A: 0.70		PA-PNZ	FR)	2.34	1.74	1.21	91.0	0.30	91.0	0.08	90.0	0.05	0.0	пр	(FT/SEC)	174.91	174.76	174.67	174.73	174.64	174.58	174.60	174.60	114.60	114.74
	UPTAĶĒ DIAMFTĒR:	AKEA RATIO, AM/AP:	DRIFICE DIAMETER:	ORIFICE BETA: 0.70	AMBIENT PRESSURES	PA-PS	(INCHES OF WATER)	2.34	1.74	1.21	0.74	0.30	0.15	90.0	90.0	90.0	0.0	HS	(LBM/SEC)	0.0	0.035	0.066	0.092	0.116	0.124	0.130	0.129	0.129	***
024/05	a n	A	80	5	ĄV	PU-PA	INCI	2.50	01.6	3.60	4.00	4.40	4.60	09.4	4.60	4.60	4.60	č	(LOM/SEC)	0.187	0.187	0.187	0.187	0.187	0.187	0.187	0.197	0.187	0.187
1/1/4.57/-024/05						TAMB	NHE LT)	75.0	15.0	75.0	75.0	15.0	75.0	15.0	75.0	75.0	75.0	55***1*M		0.0	0.1769	0.3318	0.4612	0.5850	0.6247	0.6534	0.6479	0.6513	***
-0.24		S				1 90 1	(DEGREES FAHRENHEIT)	149.0	149.0	149.0	150.0	150.0	150.0	150.0	150.0	150.0	151.0	*1/*d		0.3938	0.2934	0.2042	0.1250	0.0504	0.0245	0.0135	0.0102	0.0085	0.0
IUN, STANNUFF	-	ER: 1.732 INCHES	13.71 INCHES	3.00 INCHES		10R	(DEGF	149.0	149.0	149.0	150.0	150.0	150.0	150.0	150.0	150.0	151.0	*1		0.8784	0.8784	0.8784	0.8770	0.8770	0.8770	0.8770	0.8770	0.8770	0.8755
ANSI TION,	Y NO221.ES:				Ś	DPOR	F WATER!	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	*		0-3460	0.2577	9521-0	0.1096	0.0442	0.0215	0.0119	0.0089	0.0074	0.0
LLIPTIC TR.	NUMBER OF PRIMARY NOZZI.ES:	PRIMARY NUZZLE GLAMET	MIXING STACK LENGTH:	HIXING STACK DIAHETER:	MIXING STACK L/D:	PUR	LINCHES OF WAT	5.6	6.1	6.1	7.1	7.5	1.6	7.7	7.1	1.1	1.1	*		0.0	0.1873	0.3513	0.4886	0.6198	0.6619	0.6922	0.6864	0.6900	******
UNE NOZZLE, ELLIPTIC TRANSITI	NUMBER	PRIMAR	MIXING	MIXING	MIXING	z	RUN	-	2	m	4	v	٥	7	83	Φ	01	z	RUN	-	8	M	4	v	9	٢	80	¢	10

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

X/D: 0.0 0.5 1.0 1.5 2.0 2.5 3.0

PHSIIN. H201: 0.0 0.0 0.0 0.0 0.0 0.0

PMS*: 0.0 0.0 0.0 0.0 0.0 0.0

(f) S/D = -0.24, M

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DATA TAKEN 11 JULY 77 BY PETE HARRELL

												UPT MACH		0.083	0.083	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
	#6	ARE A CHES 1	ī	s ~	. ~	4	-	8	~:	Ą	*	3	(FI/SEC)	100.18	96*66	65.80	19*56	99.52	99.50	99.50	64.98	49.60	99.38
	3.00 INCHES : 3.00 2.154 INCHES 70 29.77 INCHES HG	SECONDARY AREA (SQUARE INCHES)	0.0	0.785	3.142	6.284	9.621	13.548	15.512	17.082	****	¥	(F1/SEC)	100.18	115.95	128.88	139.10	148.15	150.63	151.18	151.23	151.90	***
	IETER: 3.0 AM/AP: 3 AM/AP: 3 AM/AP: 3 AM/AP: 3 AM/AP: 3.0 AM/AP: 3.0 AM/AP: 3.0 AM/AP: 3.0 AM/AP: 3.0 AM/AP: 3.0	PA-PNZ (ER)	08.9	4.89	1.85	0.70	0.33	0.17	0.13	0.11	0.0	ПР	(FT/SEC)	300.57	299.90	299-45	298.85	258.59	298.52	298.52	298.48	298.48	298•16
	UPTAKE DIAMETEK: 3 AREA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIENT PRESSURE:	PA-PS PA (INCHES OF WATER)	08.9	4.89	1.85	0.70	66.0	0.17	0.13	0.11	0.0	33 33	(L.BM/SEC)	0.0	0.059	0.107	0.145	0.178	0.187	0.189	0.150	0.192	*****
084/15	5 4 C 5 4	PU ·PA	7.70	9.50	11.70	12.40	12.60	12.60	12.70	12.70	12.80	ż	(LBM/SEC)	0.324	9.325	0.326	0.326.	0.327	0.327	0.327	0.327	0.327	0.327
1/1/4.57/ 084/15		TAMB NHE I I)	13.0	73.0	73.0	73.0	13.0	73.0	73.0	73.0	73.0	55" * * LoM		0.0	0.1705	0.3090	0.4187	0.5146	0.5409	0.5466	6.5473	0.5544	****
-0.84	S S	TUPT TAM (DEGREES FAIPENHEIT)	150.0	0.051	149.0	149.0	149.0	149.0	145.0	149.0	148.0	*1/*d		0.3891	0.2811	0.1834	0.1069	0.0405	1610.0	0.0098	0.0075	9900.0	0.0
ION, STANDOFF	ZI.ES: 1 ER: 1.732 INCHES 13.71 INCHES : 3.00 INCHES	TOR (DEGI	150.0	150.0	149.0	149.0	149.0	149.0	149.3	149.0	148.3	£		0.8737	0.8737	0.8137	0.8751	0.8751	0.8751	0.8751	0.8751	0.8751	0.8766
	RY NOZZLES: DIAMETER: 1 NGTH: 13.71 AMETER: 3.0	POR DPGR LINCHES OF WATER)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	*d		0.3400	0.2456	0.1602	0.0936	0.0355	0.0167	0.0086	9900.0	0.0056	0.0
ELLIPTIC T	NUMBER OF PRIMARY NOZ: PRIMARY NUZZLE DIAMETI MIXING STACK LENGTH: MIXING STACK DIAMETER MIXING STACK 1/D: 4	POR (INCHES	16.7	18.5	19.8	21.4	21.6	21.6	21.7	21.7	21.7	*		0.0	0.1809	0.3280	0.4440	0.5457	0.5735	1615.0	0.5803	0.5879	******
ONE NOZZLE, ELLIPTIC TRANSIT	NUMBE PRIMA MIXIN MIXIN	Z Z	-	8	n 4	· w	s	~	89	6	10	z	RUN		2	m	4	S	9	7	80	6	10

> 0.0 2.0 HIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10 1.5 0.0 0.0 0.0 0.0 x/0:

PMS(IN. H20):

(g) S/D = -0.84, $M_u = 0.082$

DATA TAKEN 11 JULY 77 BY PETE HARRELL

			0.068 0.068 0.068 0.068 0.068 0.068 0.068
	не	NKFA CHES)	UU 6FT/SEC) 82.03 81.92 81.81 81.76 81.70 81.70 81.69
	.00 INCHES 3.00 2.154 INCHES 29.77 INCHES HG	SECONDARY AREA (SQUARE INCHES) 0.0 0.785 1.767 3.142 6.284 9.621 13.548 15.512 17.082	UN (FT/SEC) 82.03 95.00 105.47 114.05 121.73 122.91 124.15 123.48 123.48
	m 0	PA-PNZ fER1 4.50 3.29 2.11 1.24 0.48 0.22 0.12 0.07	UP 246.11 245.78 245.45 245.45 245.21 245.12 245.12 245.12 245.12 245.12
	UPTAKE DIAMETER: 3.00 INCHES ARFA RATIO, AM/AP: 3.00 URIFICE DIAMETER: 2.154 INCH ORIFICE BETA: 0.70 ÁMBIENT PRESSURE: 29.77 INCH	PA-PS PA (INCIES OF WATER) 4.50 4 3.28 3 2.11 2 1.24 1 0.48 0 0.22 0 0.22 0 0.09 0	MS 1 (LBM/SEC) 0.0 0.040 0.087 0.119 0.119 0.151 0.153
084/10		6.10 5.10 6.20 7.20 7.70 9.10 8.30 8.30 8.40	WP (LBM/SEC) 0.265 0.265 0.266 0.266 0.266 0.266 0.266
1/1/4.57/ 084/10		TAHB 75.0 75.0 73.0 73.0 73.0 73.0 73.0 73.0	0.0 0.1715 0.3092 0.4212 0.5211 0.5367 0.5541 0.5637
. +8*0-	V	TUPT TAH (DEGREES FAURENHEII) 0 148.0 73. 0 148.0 73. 0 148.0 73. 0 148.0 73. 0 148.0 73. 0 148.0 73. 0 148.0 73.	0.3828 0.2798 0.1805 0.1805 0.1062 0.0184 0.0059 0.0060
STANDUFF	S: 1 1.732 INCHES 71 INCHES 3.00 INCHES	108 148.0 148.0 148.0 148.0 148.0 148.0 148.0	1* 0.8156 0.8766 0.8766 0.8766 0.8766 0.8766 0.8766
ANSI TION,	Y NCZZLES: 11AMETER: 1- 16TH; 13.71 18ETER: 3.6		P* 0.3355 0.2452 0.1582 0.0931 0.0086 0.0086
ELLIPTIC TR	NUMBER OF PRIMARY NCZZLES: 1 PRIMARY NOZZLE DIAMETER: 1.732 INCHES MIXING STACK LENGTH; 13.71 INCHES MIXING STACK DIAMETER: 3.00 INCHES	16 SIALN L/19 PUR 11 NCHES C 11 - 2 13 - 2 13 - 2 14 - 2 14 - 3 14 - 4 14 - 4	0.0 0.1817 0.5277 0.5522 0.5587 0.5687 0.5766
UNIN HELD TO THE BELLEVILLE TRANSITION, STANDUFF	NOMBE POLICES NOMBE PRIMP MIXIN MIXIN	N - N A A A A A A A A A A A A A A A A A	N 1 2 4 4 4 4 6 6 0 0

1.5 2.0 2.5 -0.81 -0.61 -0.34 -0.06 -0.05 -0.03 MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 13 1.0 -0.83 -1.08 0.0 X/D: PMS(IN. H2U): PMS*:

-0.06

 $\frac{2.0}{11} - 0.61 - 0.34 - 0.13$ $\frac{2.0}{11} - 0.61 - 0.34 - 0.13$ $\frac{2.0}{11} - 0.84$, $\frac{2.0}{11} = 0.068$

Table XI. Continued.

DATA TAKEN 11 JULY 77 BY PETE HARRELL

	91	ARE A CHES)		s		~	•	-	80	2	~:	•	25	(FT/SEC	58.13	58.08	58.04	58.03	58.02	58.01	58.01	58.05	58.05	57.96
	3.00 INCHES : 3.00 2.154 INCHES 70 29.77 INCHES HG	SECONDARY AREA (SQUARE INCHES)	0.0	0.785	1.767	5.142	6.284	9.621	13.548	15.512	17.082	****	5) (FT/SEC)	58.13	67.39	14.56	80.85	85.53	86.80	87.35	86.68	87.55	* * * *
	K: 3 /AP: ER: 0.70	PA-PNZ WATER)	2.23	1.66	1.08	29.0	0.23	0.11	0.05	0.04	0.03	0.0	å) (FT/SEC)	174.39	174.26	174.13	11.4.11	174.07	174.05	174.05	174.15	174.17	173.90
	UPTAKE DIAMETEK: 3 AREA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 A181ENT PRESSURE:	PA-PS	2.23	1.66	1.08	0.62	0.23	0.11	0.05	, 0.04	0.03	0.0	MS	(LBM/SEC)	0.0	0.034	0.062	0.084	0.101	901.0	0.108	0.105	0.108	*****
084/05	5 4 0 0 4	PU-PA (INC	2.50	3.10	3.60	3.80	4.00	4.10	4.10	4.20	4.20	4.20	d #	(LUM/SEC)	0.188	0.108	0.138	0.188	0.188	0.188	0.188	0.188	0.148	0.149
1/1/4.57/ 084/05		T AMB ENHE (T.)	73.0	73:0	13.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	55°4*]*M		0.0	0.1727	0.3134	0.4221	0.5084	0.5317	0.5419	0.5291	0.5450	******
-0-84	E S	TUPI TAM (DEGREES FAHRENHEIT)	144.0	144.0	144.0	144.0	144.0	144.0	144-0	145.0	145.0	143.0	\$1/\$d		0.3753	0.2798	0.1823	0.1047	0.0380	0.0177	0.0093	9900.0	0.0059	0.0
STANOOFF	ES: 1 : 1.732 INCH .71 INCHES 3.00 INCHES	TOR	144.0	144-3	144.0	144.0	144.0	144.0	144.0	145.0	145.0	143.0	*		0.8824	0.8824	0.8824	0.8824	0.8824	0.8824	0.8824	6088.0	0.8809	0.8839
PTIC TRANSITION, STANDOFF	PRIMARY NOZZLES: 1 022LE DIAMETER: 1.732 IN ACK LENGTH: 13.71 INCHES ACK DIAMEȚER: 3.00 INCH ACK L/O: 4.57	DPUR Of WATER)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	*		0.3312	0.2469	0.1609	0.0924	0.0335	0.0157	0.0062	0.0060	0.0052	0.0
	90 N S 1 S 1 S 1 S 1 S 1 S 1 S 1 S 1 S 1 S	POR	5.6	6.2	, 9-9	6.9	7.1	1-2	7.2	7.2	7.3	7.4	*		0.0	0.1825	0.3311	0.4460	0.5372	0.5618	0.5725	0.5595	0.5763	*****
ONE NOZZLE, ELLI	NUFBER PRIMARY MIXING MIXING MIXING	N N	-	7	м	4	v	9	1	83	6	10	z	RUN		2	'n	4	v	4	7	89	ø	01

UPT MACH

0.048 0.048 0.048 0.048

0.048

0.048

MIXING STACK PRESSUKE DISTRIBUTION FUR RUN: 13

X/D: 0.0 0.5 1.0 1.5 2.0 2.5

PHS[IN. H20]: 0.0 0.0 0.0 0.0 0.0 0.0

PHS*: 0.0 0.0 0.0 0.0 0.0 0.0

(i) S/D = -0.84, $M_u = 0.048$

3.0

DATA TAKEN 14 JULY 77 BY PETE HARRELL

															UP1 MAC-1		0.083	0.083	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
		911	AREA	CHE S !		ĸ	2	2	4	-	80	~	2	·•	3	(F1/SEC)	100.30	100.08	96.66	64.66	19.66	25.66	95.55	65.66	99.55	95.28
	UPTAKE DIAMETER: 3.00 INCHES AREA RATIU, AM/AP: 3.00 ORIFICE DIAMETER: 2.154 INCHES ORIFICE BETA: 0.70	29.80 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	*****	W.D	(FI/SEC)	100.30	116.45	130.23	141.87	152.59	155.90	157.03	156.98	158.72	* * * * * * * * * * * * * * * * * * * *
	METER: 3.0 AM/AP: 3.0 AMETER: 7.17		PA-PNZ	TER.)	7.05	5.13	3.45	2.10	0.83	0.40	0.21	0.16	91.0	0.0	ā	(F1/SEC)	300.91	300.24	299.83	299.38	298.84	298.73	558.69	298.62	298.66	297.85
	HPTAKE DIAMETER: 3 AREA RATIU, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70	AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	7.05	5.13	3.45	2.10	0.83	0.40	0.21	0.16	91.0	0.0	HS	(LBM/SEC)	0.0	0.060	0.111	0.154	0.194	902.0	0.210	0.210	0.217	*****
0/15			PU-PA	Z	7.70	9.50	11.20	12.50	14.00	14.30	14.40	14.50	14.50	14.70	¥	(LBM/SEC)	0.324	0.325	0.325	0.326	0.326	0.326	0.326	0.326	0.326	0.327
1/0/3/100/15			TAMB	ENHELT)	74.0	14.0	14.0	74.0	74.0	74.0	74.0	74.0	74.0	14.0	44.**1*W		0.0	0.1747	0.3218	0.4458	0.5595	0.5945	0.6065	0.6061	0.6243	****
	ees S		1 401	(DEGREES FAHRENNEIT)	152.0	152.0	153.0	153.0	153.0	153.0	153.0	153.0	153.0	151.0	*1/*d		0.4034	0.2949	0.1992	0.1216	0.0482	0.0233	0.0122	0.0093	0.0081	0.0
00FF 1.00	2LES: 1 ER: 1.732 INCHES 9.00 INCHES : 3.00 INCHES		T 0R	106	153.0	152.0	153.0	153.0	153.0	153.0	153.0	153.0	153.0	152.0	*		0.8725	0.8725	0.8711	0.8711	0.8711	0.8711	0.8711	0.8711	0.8711	0.8739
TIUN, STANE	ARY NOZZLES DIAMETER: ENGTH: 9.0 IAMETER: 3	70: 3.00	DPOR	(INCHES OF WATER)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	* d		0.3520	0.2573	0.1735	0.1059	0.0420	0.0203	9010*0	0.0081	0.0071	0.0
NO TRANSI	NUMBER OF PRIMARY ND22LES: PRIMARY NUZZLE DIAMETER: 1. MIXING STACK LENGTH: 9.00 MIXING STACK DIAMETER: 3.	MIXING STACK L/D:	· POR	(INCHES	16.7	18.5	20.1	21.5	23.0	23.3	23.4	23.4	23.5	23.7	*		0.0	0.1855	0.3420	0.4737	0.5945	0.6317	0.6444	0.6441	0.6634	****
ONE NUZZLE, NO TRANSITION, STANDOFF 1.00	NUMB PRIM MIXII MIXII	MIXIM	z	RUN	-	7	æ	4	w	9	1	89	6.	01	z	RUN	-	2	æ	4	Ŋ	9	7	3 0	ა	01

HIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

X/D: 0.5 1.0 1.5 2.0 2.5

PHSLIII. 11201: 0.0 0.0 0.0 0.0 0.0 Tab

(a) S/D = 1.0, $M_u = 0.082$

Table XII. Single-Nozzle Performance Data for L/D = 3.0,

Straight Entrance.

DATA TAKEN 14 JULY 77 BY PETE HARRELL

															•			UPT MACH		0.068	0.068	0.068	0.068	0.068	190.0	190.0	0.067	0.067	0.067
					HG	AREA	CHES 1		z.	~	~	4	-	3	~	ي	*	Ŋ	(FT/SEC)	82.20	R2.13	82.02	81.93	R1.84	81.88	81-86	81.86	81.86	81.59
	3.00 INCHES	3.00	2.154 INCHES		29.80 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	****	N	(FI/SEC)	82.20	44.56	19.901	116.36	124.51	126.77	127.87	128.32	127.89	*****
				IA: 0.70		PA-PNZ	(ER)	4.65	3.40	2.28	1.41	0.54	0.26	51. 0	0.11	0.09	0.0	dD	(FT/SEC)	246.63	246.40	246.07	245.80	245.53	245.67	245.61	245.61	245-61	244.78
	UPTAKE DIAMETER:	AREA RATIO, AM/AP:	ORIFICE DIAMETER!	ORIFICE BETA:	AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	4.65	3.40	2.28	11	0.54	0.26	0.14	0.11	60.0	0.0	MS	(L.BM/SEC)	0.0	0.049	0.000	0.126	0.156	0.165	691.0	0.170	0.169	****
01,	3	4	C	0	<	Pij-PA	CINC	2.00	6.30	1.40	8.30	9.20	07.6	09.6	09.6	0).6	9.70	ď¥	(LBM/SFC)	0.264	0.264	0.265	0.265	0.265	0.265	0.205	0.265	0.265	0.266
01/001/6/0/10						TAMB	THE IT	14.0	14.0	14.0	14.0	74.0	74.0	14.0	14.0	14.0	74.0	77.**I*W		0.0	0.1746	0.3214	0.4490	0.5551	0.5840	0.5582	0.6040	0.5985	******
		ES				TUPT	(DEGREES FAHRENHEIT)	151.0	152.0	152.0	152.0	152.0	153.0	153.0	153.0	153.0	149.0	p*/1*		0.3955	0.2501	0.1951	0.1209	0.0464	0.0219	0.0116	0.0000	0.0073	0.0
ANDUFF 1.00	~	1.732 INCHI	9.00 INCHES	3.00 INCHES		10R	(366)	151.0	152.0	152.0	152.0	152.0	153.0	153.0	153.0	153.0	149.0	*1		0.8739	0.8725	0.8725	0.8725	0.8725	0.8711	0.8711	0.8711	0.8711	0.8768
ON. STANDE	Y NOZZLES	NAMETER: 1	1GTH: 9.0C		3.00	DPUR	IF WATER)	10.0	10.0	10.0	0.01	10.0	10.01	10.0	10.0	10.0	10.0	*d		0.3456	0.2531	0.1702	0.1055	0.0405	1610.0	0.0101	0.0079	0.0054	0.0
CHE NO22LE, NU IRANSITION, SI	NUMBER OF PRIMARY NOZZLES:	PRIMARY NOZZLE DIAMETER: 1.732 INCHES	MIXING STACK LENGTH:	MIXING STACK DIAMETER:	MIXING STACK L/D: 3.00	POR	(INCHES OF WATER)	11-1	12.3	13.4	14.3	15.2	15.4	15.6	15.6	15.6	15.7	*		0.0	0.1854	0.3413	0.4768	5685*0	0.6205	0.6357	0.6419	0.6360	******
CNE NO22LE, NO TRAN	NUMBE	PRIM	MIXIM	MIXIM	MIXIM	z	RUN	-	2	М	4	'n	•	7	80	٥	10	z	RUN		2	9	4	ď	9	7	89	٥	01

MIXING STACK PRESSURE DISTRIBUTION FOR RUH: 10

X/D: 0.5 1.0 1.5 2.0 2.5

PMSIIN. H201: -1.41 -0.89 -0.63 -0.36 -0.14

PMS: -0.11 .0.07 -0.05 0.03 0.01

Table XII. Continued.

(b) S/D = 1.0, $M_u = 0.068$

HARRELL
PETE
β
11
JULY
7
TAKEN
DATA

ONE NUZZLE, NO TRANSITION, STANDOFF 1.00

1/0/3/100/05

												UPT MACH	,	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
914	AREA CHES)		ĸ	~	7	•	-	80	~	8		20	(FT/SEC)	58.24	58.19	58.16	58.12	58.14	58.08	58.12	58.12	58.18	58.07
UPTAKE DIAMETER: 3.00 INCHES AKEA RATIO, AM/AP: 3.00 ORIFICE DIAMETER: 2.154 INCHES URIFICE BETA: 0.70 AMBIENT PRESSURF: 29.80 INCHES HG	SECONDARY AREA (SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	***	¥ n	(FT/SEC)	58.24	67.59	15.87	82.40	88.32	90.17	91.27	11.16	93.50	****
ETER: 3.0 AM/AP: 3 METER: 2. A: 0.70 SSURF: 26	PA-PNZ ER1°	2.30	1.69	1.18	0. 10	0.27	61.0	0.07	90.0	0.05	0.0	ŝ	(FT/SEC)	174.74	174.55	174.48	174.37	114.43	174.26	174.39	174.39	174.55	174.22
UPTAKE DIAMETER: 3.00 f AKEA RATIO, AM/AP: 3.00 ORIFICE DIAMETER: 2.154 URIFICE BETA: 0.70 AMBIENT PRESSURF: 29.80	PA-PS PA-	2.30	1.69	1.18	0.10	0.27	0.15	10.0	0.05	0.05	0.0	¥.	(LBM/SEC) (FT/SEC)	0-0	0.035	0.065	0.089	0.111	0.117	0.121	0.123	0.129	*****
3 4 5 5 4	PU -PA (INC	2.50	3.10	5.70	4.10	09-5	4.70	4.80	4.80	4.80	06*+	A M	(LBK/SEC)	0.187	0.187	0.188	0.148	0.188	0.188	0.188	0.188	0.188	0.188
	TAMB NHEIT)	15.0	15.0	15.0	15.0	75.0	15.0	15.0	75.0	15.0	15.0	55"**1*A		0.0	0.1743	0.3275	0.4484	0.5566	0.5912	0.6109	0.6200	0.6510	*****
E S	TUPT TAM (DEGREES FAIRENHEIT)	147.0	147.0	147.0	147.0	148.0	147.0	148.0	148.0	149.0	147.0	*1/*d		0.3871	0.2845	0.1992	0.1183	0.0457	0.0220	0.0119	0.0093	0.0085	0.0
ER: 1.732 INCHES 9.00 INCHES : 3.00 INCHES	T OR (DEG	147.0	147.0	147.0	147.0	148.0	147.0	148.0	148.0	149.0	147.0	*		0.8813	0.8813	0.8813	0.8813	0.8799	0.8813	0.8799	0.8799	0.8784	0.8813
Y NOZZLES DIAMETER: VGTH; 9.00 WRTER: 3.00	DPOR JF WATER)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	* d.		0.3412	0.2511	0.1756	0.1043	0.0402	0.0194	0.0104	0.0082	0.0074	0.0
NUMBER OF PRIMARY NOZZLES: PRIMARY NOZZLE DIAMETER: L. HIXING STACK LENGTH; 9.00 HIXING STACK DIAMETER: 3.0	POR DPOR	5.6	6-1	8.9	7.1	1.1	7.8	7.9	1.9	8.0	8.0	*		0.0	0.1842	0.3463	0.4740	0.5889	0.6250	0.0463	0.6559	0.6892	****
NUMBEI PRIMAE MIXING MIXING MIXING	N NON	-	2	w	4	s	9	1	8	6	01	z	RUN	-	~	ю	4	Ŋ	ş	1	89	6	01

(c) S/D = 1.0, $M_u = 0.048$ Table XII. Continued.

2.5

2.0

0.0

0.0

0.0

X/0: PHS(IN. H20): PHS*:

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

DATA TAKEN 14 JULY 77 BY PETE HARRELL

															IJPT MACH		0.083	0.083	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
		911	ARF A	CHES)		ς.	2	8	4	-	8	2	2	*	20	(FT/SEC)	100.45	100.23	100.10	99.95	61.66	18.56	66-66	62.56	64.66	44.66
3.00 INCHES	2.154 INCHES	29.80 INCHES HG	SECONDARY ARFA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	****	¥	(FT/SEC)	100.45	116.40	130.19	141.66	151.84	156.17	159.33	159.04	160.05	*****
	METER: 2. A: 0.70		PA-PNZ	ERI	7.00	5.00	3.40	2.06	0.80	0.40	0.23	0.17	0.15	0.0	ď	(FT/SEC)	301.37	300.70	300-31	299.87	299.40	299.46	299.45	299.39	299.39	298.34
UPTAKE DIAMETER: 3 AREA RATIO, AM/AP:	ORIFICE DIAMETER: ORIFICE BETA: 0.70	AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	7.00	2.00	3.40	2.06	0.80	0,40	0.23	0.17	0.15	0.0	MS	(LBM/SEC)	0.0	0.059	0.110	0.153	0.190	0.206	0.218	0.216	0.220	*****
5 ₹	5 5	₹	PU-PA	CINC	7.80	09.6	11.30	12.60	13.80	14.30	14.40	14.50	14.50	14.70	ž	(LBM/SEC)	0.324	926.0	0.325	0.325	0.326	0.326	0.326	0.326	978.0	128.0
			IAMB	NHE I T.	15.0	15.0	15.0	15.0	15.0	75.0	15.0	75.0	75.0	15.0	55°441*M		0.0	0.1724	0.3195	0.4414	0.5495	9,65.0	0.6279	0.6248	0.6354	*******
S			TUPT	(DEGREES FAHRENHEIT)	154.0	154.0	155.0	155.0	155.0	156.0	156.0	156.0	156.0	152.0	P*/1*		0.4007	0.2875	0.1963	0.1193	0.0465	0.0233	0.0131	0.0099	0.0084	•
: 1 1.732 INCH	9.00 INCHES		10%	(DEG	154.0	154.0	155.0	155.0	155.0	156.0	156.0	156.0	156.0	152.0	<u>*</u>		0.8713	0.8713	0.8698	0.8698	0.869R	0.8684	0.8684	0.8684	0.8684	0 8741
NY NOZZĽES: JIAMETER:	6 :	8	DPOR	(INCHES OF WATER)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	*		0.3491	0.2504	0.1707	0.1038	0.0404	0.0202	0.0114	0.0086	0.0073	•
NUMBER OF PRIMARY NOZZĽES: 1 PRIMARY NOZZLE DIAMETER: 1.732 INCHES	MIXING STACK LENGTH: "	MIXING STACK L/D: 3.00	POR	(INCHES (16.8	18.6	20.3	21.7	22.8	23.3	23.4	23.5	23.5	23.1	•		0.0	0.1832	0.3397	0.4694	0.5842	0.6326	1899.0	0.6648	0.6761	***
NUMBE PRIMA	MIXIM	MIXIM	z	RUN		2	'n	4	'n	9	7	60	6	10	z	SC N	-	8	'n	4	v	9	,	3 0	٥	

HIXING STACK PRESSURE DÍSTRIBUTION FOR RUN: 10

X/D: 0.5 1.0 1.5 2.0 2.5

PHS[IN. H20]: 0.0 0.0 0.0 0.0

PHS*: 0.0 0.0 0.0 0.0

(d) S/D = 0.75, $M_u = 0.082$ Table XII. Continued.

HARRELL
PETE
8
11
JULY
14
TAKEN
DATA

													UPT MACH		0.068	0.068	0.068	0.068	0.068	0.067	0.067	0.067	0.067	0.067
	H G	AREA CHES)		2	~	~	•	-	œ	2	~	*	n n	(FT/SEC)	82.25	82.14	R2.01	81.93	98.18	81.92	81.72	81.74	81.67	R1.52
	3.00 INCHES : 3.00 2.154 INCHES 70 29.80 INCHES HG	SECONDARY AREA (SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	***	5	(FT/SEC)	82.25	95.37	106.47	1-15-91	123.57	126.33	126.94	127-15	156.41	***
	ETER: 3.0 AM/AP: 3 METER: 2. A: 0.70 SSURE: 29	PA-PNZ ER J	4.59	3.35	2.25	1.37	0.52	0.25	0.13	01.0	0.08	0.0	ч	(LBM/SEC) (FT/SEC)	246.11	246.43	246.04	245.80	245.59	14.545	245.18	245.24	245.04	244.57
	UPTAKE DIAMETER: 3. AREA RATIO, AN/AP: ORIFICE DIAMETER: 2 URIFICE BETA: 0.70 AMBIENT PRESSURE: 2	PA-PS PA	4.59	3.35	2.25	1.37	0.52	0.25	0.13	01.0	90.0	0.0	S A	(LBM/SEC)	0.0	0.049	0.000	0.124	0.153	0.163	0.165	0.166	0.154	*****
10	5 4 5 5 4	PU-PA	5.10	6.30	1.50	8.30	01.6	9.50	9.70	09.6	09.6	9.70	ă	(LBM/SEC)	0.264	0.265	0.265	0.265	0.265	0.266	0.266	0.266	0.266	0.266
1/0/3/0/2/10		TAMB	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	74.44 T#N		0.0	0.1733	0.3192	0.4425	0.5421	0.5780	0.5868	0.5892	0.5803	***
	s ;	TUPT TAME (DECREES FAHRENHEIT)	0.521	152.0	152.0	152.0	152.0	152.0	151.0	151.0	150.0	148.0	p#/1¢		0.3905	0.2856	0.1926	0.1175	0.0442	0.0215	0.0112	0.0086	0.0069	0.0
FF 0.75	LES: 1 R: 1.732 INCHE 9.00 INCHES 3.00 INCHES	TOR	152.0	152.0	152.0	152.0	152.0	152.0	151.0	151.0	150.0	148.0	*		0.8741	0.8741	0.8741	0.8741	0.8741	0.8741	0.8755	0.8755	0.8770	0.8799
ON, STAMBO	Y NOZZLES: 1AMETER: 1 GTH: 9.00 METER: 3.	DPOR F WATER)	10.0	10.0	10.0	10.0	10.0	0.01	10.0	10.0	10.0	10.0	*		0.3414		0.1683	0.1027	0.0387	0.0188	8600.0	0.0075	0.0060	0.0
MO TRANSITE	NUMBER OF PRIMARY NOZZLES: I PRIMARY NOZZLE DIAMETER: 1.732 INCHES MIXING STACK LENGTH: 9.00 INCHES MIXING STACK DIAMETER: 3.00 INCHES MIXING STACK L/0: 3.00	POR DPOR	11.1	12.4	13.5	14.3	15.2	15.6	15.7	15.7	15.7	15.7	*	:	0.0	0-1839	0.3387	0.4695	0.5751	0.6132	0.6221	0.6247	0.6148	*****
ONE NOZZLE, MO IRANSITION, STAMBOFF	NUMBE PRIMA MIXIN MIXIN	2 2	<u>-</u>		l m	4	. <i>r</i> u	. 40	. ~	· so	6	01	z	,		۰ ۸	יה ו	· 4	· v	\ \		- 00	• •	01

MIXING STACK PRESSURE DISTRIBUTION FUR RUN: 10

X/D: 0.5 1.0 1.5 2.0 2.5

PMS(IN. H20): -1.64 -1.13 -0.13 -0.39 -0.15

PMS*: -0.12 -0.09 -0.05 -0.05 -0.01

(e) S/D = 0.75, $M_u = 0.068$ Table XII. Continued.

DATA TAKEN 14 JULY 77 BY PFIE HARRELL

												UPT MACH		0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
911	(REA CHES)		10		N			80	۷.	~	•	25	(FT/SEC)	58.34	58.29	58.25	58.26	58.23	58.23	58.21	58.27	58.27	58.17
3.00 INCHES 3.00 2.154 INCHES 0	SECCINDARY AREA (SQUARE INCHES)	0.0	0.785	1.767	3-142	6.284	5.621	13.548	15.512	17.082	***	¥	(FT/SEC)	58.34	67.68	15.65	82.26	48.18	99*68	91.35	91.89	93.57	****
ETER: 3.0 AM/AP: 2 4ETER: 2.4 A: 0.70 SSURE: 29	PA-PNZ ER)	2.29	1.69	1.14	69.0	92 • 0	0.13	10.0	0.05	0.05	0.0	ď	(F 1/SEC)	175.02	174.89	174.76	174.80	174.71	114.69	174.65	174.82	174.82	174.51
UPTAKE DIAMETER: 3 AREA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIENT PRESSURE:	PA-PS PA	2.29	1.69	1-14	69*0	0.26	0.13	10.0	0.05	0.05	0.0	МS	(LBM/SEC)	0.0	0.035	990.0	0.088	0.108	0.115	0.121	0.123	0.129	****
A G G A	PU-PA (INC)	2.50	3.10	3.70	4.20	4.60	4.70	4.80	4.80	4.80	4.90	a X	(ILBM/SEC)	0.187	0.187	0.187	0.187	0.187	0.187	0.187	0.187	0.187	
	TAM8	15.0	15.0	75.0	75.0	75.0	15.0	75.0	75.0	15.0	75.0	Wc74.44		0.0	0.1743	0.3220	0.4436	0.5463	0.5799	0.6111	0.6202	0.6512	*****
82	TUPT TAM	149.0	149.0	149.0	150.0	150.0	150.0	150.0	151.0	151.0	149.0	\$1/*d		0.3854	0.2849	0.1924	0.1158	0.0440	9.0212	0.0119	6.00.0	0.0085	
LES: 1 9:00 INCHES 3:00 INCHES	TDR (12568	149.0	149.0	149.0	150.0	150.0	150.0	150.0	151.0	151.0	149.0	ř		0.8784	0.8704	0.8784	0.8770	0.8770	0. 87 70	0.8770	0.8755	0.8755	
Y NOZZLES: JIAMETER: 1 JGTH: 9-00 METER: 3-00	DPOR IF WATER)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	*		0.3386	0.2502	0.1690	0.1015	0.0386	0.0186	0.0104	0.0082	0.0074	•
NUNDER OF PRIMARY NOZZLES: 1 PRIMARY NOZZLE DIAMETER: 1.732 INCHES HIXING STACK LENGTH: 9.00 INCHES HIXING STACK DIAMETER: 3.00 INCHES HIXING STACK L/D: 3.00	POR DPOR	5.6	6.2	8-9	7.3	1.1	7.8	7.8	7.9	6.1	8.0	*		0.0	0.1845	0.3409	0.4700	0.5788	0.6144	4749.0	0.6575	4069.0	
NUMBER PRIMAL HIXING AIXING HIXING	s S	_	2	æ	4	v	9	7	80	6	10	z	RUN		2	'n	4	ĸ	9	7	œ	o	•

HIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

X/D: 0.5 1.0 1.5 2.0 2.5

PMS(IN. H20): 0.0 0.0 0.0 0.0

PMS*: 0.0 0.0 0.0 0.0

(f) S/D = 0.75, $M_u = 0.048$ Table XII. Continued.

DATA TAKEN 15 JULY 77 BY PETE HARRELL

ONE NOZZLE, NO TRANSITION, STANDOFF (,50

17.07.37050715

The second secon

							-								UPT NACH		0.083	0.063	0.082	0.082	0.082	0.082	0.082	0.082	0.042	0.082
		HG	AKEA	CHESI		ĸ		~1	*	_	•	~	~	•	3	(F1/SEC)	100.16	96.66	04.45	99.57	99.42	95.21	99.18	94.18	99.35	98.99
3.00 2.154 INCHES		29.77 INCHES HG	SECONDARY AKEA	(SQUARE INCHES!	0.0	0.785	1.767	3.142	6.284	1:4.6	13.548	15.512	17.082	• • • • • • • • • • • • • • • • • • • •	5	(F1/SEC)	100.16	115.66	129.12	139.92	149.15	151.41	15.281	151.83	151.66	***
	0.70		PA-PN2	ER)	6.82	4.88	3.27	1.54	0.74	0.35	0.18	0.14	0.11	0.0	ч	(LUM/SEC) (FT/SEC)	300.50	299.83	299.13	298.73	298.29	297.65	297.55	297.55	298.07	296.98
AREA RATIO, AM/AP: Urifice diameter:	OKIFICE BETA:	AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	6.82	4.88	3.27	1.94	0.74	0.35	0.18	0.14	0.11	0.0	# S	(LUM/SEC)	0.0	0.059	0.109	0.149	0.183	261.0.	0.195	0.194	0.192	****
4 9 6	¥	PU-PA	(INC	1.50	9.70	11.50	12.70	13.90	14.30	14.50	14.50	14.50	14.70	a. R	(1.8M/SEC)	0.325	0.325	0.326	0.326	0.327	0.328	0.328	0.328	156.0	0.338	
	va.		TAMB	4HE1T)	11.0	71.0	71.0	0.17	71.0	71.0	71.0	71.0	71.0	71.0	44 1 eM		0.0	0.1703	0.3132	0.4284	9925.0	v.5520	0.5614	0.5566	0.5534	****
ES			TUPT	(DEGREES FAIRENHELT)	150.0	150.0	150.0	150.0	150.0	148.0	148.0	148.0	150.0	146.0	p*/13		0.3904	0.2806	ó. 1889	0.1124	1250.0	0.0201	0.0105	0°0016	n. 0064	•
ER: 1.732 (VCHES 9.00 INCHES	3.00 INCHES	S TIME OF	1 0%	(DEG	150.0	150.0	150.0	150.0	150.0	148.0	148.0	148.0	150.0	146.0	±		0.0704	0.8704	0.8704	0.8704	0.8704	0.8733	0.8733	0.8733	0.8704	0.8762
	ι.	3.00	DPOR	F HATER!	15.0	15.0	15.0	15.0	. 0.21	15.0	15.0	15.0	15.0	15.0	å		0.3599	0.2443	0.1644	0.0978	0.0372	0.0175	0.0091	6900*0	0.0056	0.0
PH'MARY NUZZLE CIAMET MIX745 STACK LENGTH;	MIXIN. STACK DIAHETER	MITTING STACK L/D:	20F	(INJHES OF WATER)	6.26	18.7	20.4	21.7	22.9	23.3	23.4	23.4	23.5	23.6	*		0.0	0.1811	0.3330	0.4553	0.5597	0.5859	0959	0.5908	0.5882	******
PRIMAL	MIXIN	WI:ING	z	RUR	-	. ~	m	4	5	¥	1	80	6	01	z	RUN	-	~	к ι	4	'n	•	7	8	6	• 01

HIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

X/D: 0.5 1.0 1.5 2.0 2.5

PMS(IN. H2Q): 0.0 0.0 0.0 0.0 6.0

PMS*: 0.0 0.0 0.0 0.0 0.0

(g) S/D =0.50, M_u = 0.082 Table XII. Continued

HARRELL
PFTE
7
1
3067
2
TAKEN
ATA

<u>(</u>>

ONE NUZZLE, NO TRANSITIFIN, STANDOFF 0.50

01/050/8/0/10

													UP T MACH		0.068	0.068	0.068	0.06H	0.068	890.0	0.068	0.068	0.068	0.068
92	IREA	:HE S)			_	•			~	•	•	_	3	(F1/SEC)	82.0B	81.83	41.66	H1.56	81.50	81.45	81.45	81.45	A1.40	81.30
3.00 thenes 3.00 2.154 thenes 2.154 thenes no	SECUNDARY AREA	(SQUAKE INCHES)	0.0	0.785	1.767	3.142	4.284	9.4.21	13.548	15.512	17.082	••••••	s:n	(FT/SEC)	R2.0R .	46.48	105.66	114.82	123.09	126.72	129.06	128.93	124.75	• • • • •
ETER: 3. AM/AP: HETER: 2 A: 0.70 SSURE: 2	PA-PN2	ERJ	4.54	3.31	2.18	1.32	0.52	0.26	0.15	0.11	60.0	0.0	Δħ	(F1/SEC)	246.26	245.52	244.98	244.68	244.50	244.38	244.35	244.35	244.38	24.3.92
UPTAKE DIAMETEM: 3.00 INCHES AREA RATIO, AM/AP: 3.00 ORIFICE DIAMETER: 2.154 INCHORLEGE BETA: 0.70 AMBIENT PRESSURE: 29.77 INCH	PA-PS	INCHES OF WATER!	4.54	16.6	2.18	1.32	0.52	92.0	0.15	0.11	0.09	0.0	#S	(LBM/SEC) (FT/SEC)	0.0	0.048	0.089	0.123	0.153	0.167	0.175	0.175	0.174	*****
5 4 5 5 4	PtJ-PA	UNC	5.20	04.9	7.50	8.40	9.10	9.40	9.50	9.50	9.50	09.6	ŝ	(LBM/SEC)	0.265	0.266	0.266	0.266	0.267	0.267	0.267	0.267	0.267	0.267
	TAMB	NHE IT)	11.0	71.0	0.11	71.0	0.17	0.17	11.0	71.0	11.0	0.11	W. T 44		0.0	0.1722	0.3142	64549	0.5420	0.5895	0.6198	0.6101	0.6156	******
es S	TUPT	(DEGREES FAHRENHEIT)	149.0	147.0	146.0	146.0	146.0	146.0	146.0	146.0	146.0	144.0	p+/1+		9986.0	0.2825	0.1865	0.1132	0.0442	0.0224	0.0125	6600.0	0.0017	0.0
1.65: 1 R: 1.732 INCH 9.00 INCHES 3.00 INCHES	Ę Š	(086	149.0	147.0	146.0	146.0	146.0	146.0	146.0	146.0	146.0	144.0	:		0.8719	0.8747	0.8762	0.8762	0.8762	0.8762	0.8762	0.8762	0.8762	0.8791
AY NUZZLES: DIAMETER: NGTH: 9.00 ANETER: 3	OPUR	(INCHES OF WATER)	10.0	10.0	. 0.01	10.0	10.0	0.01	10.0	10.0	1.0.0	10.0	*d		0.3369	0.2471	0.1634	0.0992	0.0388	9610.0	6010.0	0.0083	8700.0	0.0
NUMBER OF PRIMARY NUZZLES: I PRIMARY NOZZLE DIAMETER: 1.732 IVCHES MIXING STACK LENGTH: 9.00 INCHES MIXING STACK DIAMETER: 3.00 INCHES MIXING STACK L/D: 3.00	POR	LINCHES	11.2	12.5	13.6	14.4	15.2	15.4	15.5	15.5	15.6	15.6			0.0	0.1827	0.3330	0.4603	0.5744	0.6248	0.6569	0.6551	0.6525	******
NUMBE PRIMA MIXIN MIXIN	z	RUN	-	8	m	4	ហ	۰	7	æ	ø	01	z	RUN		8	m	4	ស	9	~	80	6	10

HIXING STACK PRESSURE DISTRIBUTION FOR HUN: 10

X/D: 0.5 1.0 1.5 2.0 2.5

PHS(1N. H2O): -1.81 -1.37 -0.90 -0.49 -0.20

PHS*: -0.14 -0.10 -0.07 -0.01

(h) S/D = 0.50, $M_u = 0.068$ Table XII. Continued.

DATA TAKEN 15 JULY 77 BY PETE HARRELL

I.

ONE NOZZLE, NO TRANSITION, STANDOFF 0.50

1/0/3/050/05

																	UPT MAGH		0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
				55	AREA	CHF S.)		ĸ	-	~:	÷	-	60	~	~	•	3	(F1/SEC)	16.18	57.93	57.94	54.92	57.88	57.52	57.91	57.96	57.96	57.87
3.00 INCHES	1.00	2.154 INCHES		29.77 INCHES HG	SECONDARY AREA	(SQUARE INCILES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	*****	W)	(FT/SEC)	57.97	67.22	74.90	81.15	86.84	88.64	89.75	89.43	91.36	•
			A: 0.70		PA-PN2	EK)	75.5	1.66	1.10	9.65	0.25	0.12	20.0	0.05	0.04	0.0	d D	(FT/SEC)	13.61	173.81	173.84	173.76	173.65	173.17	173.75	173.90	173.90	13.61
UPTAKE DIAMETER:	AREA RATIO, AM/AP:	URIFICE DIAMETER:	ORIFICE BETA: 0.70	AMDIENT PRESSURE:	PA-PS	(INCHES OF WATER)	2.27	99.1	1.10	9.65	0.25	0.12	0.07	90.0	0.04	0.0	MS	(LBM/SEC)	0.0	0.034	0.063	900.0	0.107	0.113	0.117	0.118	0.123	*****
'n	ΥY	¥	a, O,	A	P1) -PA	LINCH	2.60	9.20	3.70	4.10	4.60	4.70	4.80	4.80	4.80	4.80	ż	(LUM/SEC)	0.189	0.188	0.188	0.188	0.189	0.188	0.188	0.138	0.189	0.189
					TAMB	NIF 11)	71.0	71.0	71.0	71.0	11.0	71.0	71.0	. 71.0	71.0	71.0	75.4.1*W		0.0	0.1727	0.3162	0.4304	0.5355	0.5680	0.5886	0.5912	0.6176	****
	S				1 UP 1	(DEGREES FAHRENIFIT)	141.0	141.0	145.0	142.0	145.0	143.0	143.0	144.0	144.0	142.0	P*/T*		0.3822	0.2799	0.1857	0.100	3423	0.0203	0.0110	0.0085	0.0076	0.0
	ER: 1.732 INCHES	9.00 INCHES	3.00 INCHES		TOR	(DEG	141.0	141.0	142.0	145.0	145.0	143.0	143.0	144.0	144.0	142.0	*		0.8835	0.8835	0.88.0	0.8820	0.8820	0.8805	0.8805	0.8791	0.8791	0.8820
Y N022LES:			••	3.00	DPUR	F WATER)	5.0	5.0	5.0	5.0	5.0	9.0	5.0	5.0	5.0	5.0	4		0.3377	0.2473	0.1638	0.0961	0.0373	0.0179	1600.0	0.0074	0.0067	0.0
NUMBER OF PRIMARY NOZ	PRIMARY NOZZLE DIAMET	MIXING STACK LENGTH:	MIXING STACK DIAMETER	MIXING STACK L/D: 3	POR	(INCHES OF WAT	. 5.6	6.3	6.8	1.2	7.7	7.8	7.9	6.7	6.1	7.9	*		0.0	0.1823	0.3342	0.4548	0.5660	0.6008	0.6225	0.6257	0.6536	***
NUMBER	PRIMA	MIXIM	MIXIN	MIXIM	z	RUN	-	7	ж	4	v	9	1	8	6	10	z	RUN		8	m	4	v	9		8	J	01

HIXING STACK PRESSURE DISTRIBUTION FUR RUN: 10

X/D: 0.5 1.0 1.5 2.5

PMS(1N. H2O): 0.0 0.0 0.0 0.0

PMS*: 0.0 0.0 0.0 0.0

(i) S/D = 0.50, $M_U = 0.048$ Table XII. Continued.

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DATA TAKEN 15 JULY 77 BY PETE HARRELL

ONE NOZZLE, NO TRANSITION, STANDOFF 0.25

1/0/3/025/15

												•	UPT 4ACH		0.003	0.003	0.082	0.082	0.082	590.0	0.082	0.082	0.083	0.082
94	ARFA	CHEST		S	~	~	4		60	~	~	•	3	(F 1/SEC)	100.05	69.69	99.63	99.50	99.46	14.66	66.55	99.39	99.39	99.21
3.00 INCHES 3.00 2.154 INCHES 0 29.77 INCHES HG	SECUNDAKY ARFA	(SQUARE INCIVES)	0.0	0.785	1.767	3.142	4.284	9.621	13.548	15.512	17.082	*******	¥	(F1/SFC)	100.05	115.49	127. 76	137.87	145.90	148.11	148.60	148.00	148.04	•
<i>m</i> ===	- PN2		89.9	4.70	2.98	1.75	99.0	0° 30	91.0	0.12	0.10	0.0	3	(F1/SEC)	300.17	15.662	298.92	298.52	298.40	298.25	298.18	298.18	25 4.18	297.65
UPTAKE DIAMFTER: 3 AREA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 AHBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	6.68	4.70	2.98	1.75	0.64	0.30	0.16	0.12	01.0	0.0	S #	(I.BM/SEC)	0.0	0.058	0.103	0.141	0.171	0.179	0.181	0.178	0.175	*****
3 4 5 5 4	PU-PA	(INC	8.10	05.6	11.50	12.70	13.60	14.00	14.20	14.20	14.20	14.30	3	(LBM/SEC)	0.325	0.326	0.326	0.327	156.0	121.0	156.0	0.327	0.327	0.328
	TAMB	HELT)	72.0	72.0	72.0	72.0	72.0	12.0	12.0	72.0	72.0	12.0	74. ** 1 *W		0.0	0.1671	0.2989	1905.0	6165.0	0.5149	0.5211	0.5139	0.5144	******
S	TUPT	(DEGREFS FAHRENHEIT)	149.0	149.0	149.0	149.0	150.0	150.0	150.0	150.0	150.0	148.0	P*/1*		0.3826	0.2704	0.1721	0.1014	0.0372	0.0174	0.0000	1,000.0	0.0055	0.0
LES: 1 R: 1.732 INCHE 9.00 INCHES 3.00 INCHES	108	OEGF	149.0	149.0	149.0	149.0	150.0	150.0	150.0	150.0	150.0	148.0	*		0.8735	0.8735	0.8735	0.8735	0.8721	0.8721	0.8721	0.8721	0.8721	0.8749
Y NUZZLES: 11AMETER: 1 1GTH: 9.00 1METER: 3.	UPOR	F WATER!	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15:0	15.0	*d		0.3342	0.2362	0.1504	0.0885	0. 0324	0.0152	0.0079	0.0058	0.0048	0.0
NUMBER OF PRIMARY NUZZLES: I PRIMARY NOZZLE DIAMETER: 1.732 INCHES MIXING STACK LENGTH: 9.00 INCHES MIXING STACK DIAMETER: 3.00 INCHES MIXING STACK L/D: 3.00	POR	(INCHES OF WATER)	17.1	18.9	20.5	21.8	22.6	23.0	23.2	23.2	23.2	23.3	*		0.0	6.1173	0.3173	0.4316	0.5220	0.5469	0.5535	0.5458	0.5463	*****
NUMBER PRIMAR MIXING MIXING MIXING	z	RUN	-	2	m	4	s	¥	7	8	o,	10	z	RUN	-	2	3	4	ď	9	7	8	5	* 01

HIXING STACK PRESSURE DISTRIBUTION FUR RUN: 10

X/D: 0.5 1.0 1.5 2.0 2.5

PMS(IN. H2U): 0.0 0.0 0.0 0.0

PMS*: 0.0 0.0 0.0 0.0

(j) S/D = 0.25, $M_{u} = 0.082$ Table XII. Continued.

DATA TAKEN 15 JULY 77 BY PETE HARRELL

										•			UPT SACO		0.068	0.068	0.068	0.048	0.068	0.068	0.068	0.068	0.068	920.0
	H 6	AP EA ICHE S)		v.		'n	•	=	89	~	~	•	3	(F1/SEC)	82.00	81.83	81.13	81.69	81.63	81.81	81.80	81.72	81.72	81.53
	3.00 INCHES 1 3.00 2.154 INCHES 70 29.77 INCHES HG	SECONDARY APEA (SQUARE INCHES)	0.0	0.785	1.767	3.14?	6.284	9.621	13.548	15.512	17.082	*****	¥	(FT/SEC)	05.00	24.12	104.95	113.16	120.53	123.91	125.95	125.85	124.89	****
	HETER: 3.0 AM/AP: 3 AMETER: 2. TA: 0.70 SSURE: 29	PA-PNZ IER1	4.45	3.17	5.03	1.10	0.45	0.23	0.13	01.0	0.08	0.0	чъ	(F1/SEC)	246.02	245.66	245.33	545.09	244.91	245.45	245.42	245.19	245.19	244.61
	UPTAKE DIAMETER: 3.00 I AKEA RATIU, AM/AP: 3.00 URIFICE DIAMETER: 2.154 URIFICE BETA: 0.70 AMBIENT PRESSURE: 29.77	PA-PS PA	4.15	3.17	5.03	1.18	0.45	0.23	0.13	0.10	0.08	0.0	X X	(LBM/SFC)	0.0	0.047	0.085	0.116	6.143	0.155	0.163	0.162	0.159	****
710		PU-PA	5.30	6.50	7.60	8.40	00.6	9.20	9.30	05.6	05.6	05.6	3	(L BM/SEC)	0.265	0.265	0.266	0.266	0.266	0.245	0.266	0.266	0.266	0.266
1/0/3/025/10		TAMB NHE I T)	72.0	12.0	12.0	72.0	72.0	72.0	12.0	12.0	72.0	12.0	55***!*M		0.0	0.1685	0.3032	0.4106	0.5068	0.5487	0.5758	0.5746	0.5623	*******
	ES	TUPT TAM	148.0	148.0	148.0	148.0	148.0	151.0	151.0	150.0	150.0	147.0	P*/1*		0.3788	0.2707	0.1738	0.1012	0.0387	0.0193	0.0107	0.0082	0.0064	0.0
3FF 0.25	ER: 1.732 INCHES 9.00 INCHES : 3.00 INCHES	TOR (DEG	148.0	148.0	148.0	148.0	148.0	151.0	151.0	150.0	150.0	147.0	<u>*</u>		0.8749	0.8749	0.8743	0.8749	0.8749	0.8706	0.8706	0.8721	0.8721	0.8764
IGN, STANDOFF	TY NOZZLES: DIAMETER: GGTH: 9.00 ANETER: 3.	DPOR JF WATER)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	0.01	10.0	10.0	đ	•	0.3314	0.2368	0.1521	0.0886	0.0338	0.0168	0.0094	0.0071	0.0056	0.0
NO TRANSIT	NUMBER OF PRIMAFY NUZZLES: PRIMARY NGZZLE DIAMETER: 1 MIXING STACK LENGTH: 9.00 MIXING STACK DIAMETER: 3.0	POR DPOR	11.3	12.5	13.6	14.4	15.0	15.2	15.3	15.4	15.4	15.5	*		0.0	0.1787	0.3215	0.4355	0.5375	0.5832	0.6120	0.6103	0.5972	******
CNE NOZZLE, NO TRANSITIÚN, SI	NUMBE PRIMA MIXIN MIXIN	Z Z S	-	۰ ۵	. m	4	Ś	9	~	80	ø	01	z	S S	-	. 2	M	4	· w	• •	2	80	v	10

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

X/D: 0.5 1.0 1.5 2.0 2.5

PHS(IN. H2O): -1.81 .1.42 -1.06 -0.59 -0.24

PHS(IN. H2O): -0.14 -0.11 -0.08 0.04 0.02

(k) S/D = 0.25, M_u = 0.068 Table XII. Continued.

JATA TAKEN 15 JULY 77 BY PETE HARRELL

																		UPT HACH	SEC.)	11 0.04R	0.048 O.048	03 0.048	0.048				0.048	0.048	0.048	0	.048	Poi
40		HES		HES HG	DV AVEA	TOURSE INChes	Turies .	0.0	0.785	1.767	3.142	6.284	9.621	3.548	15.512	17.082	•	n n	C) (FT/SEC)	58.11	58.07	58.03	58.01	58.03	58.02	58.01	58.02	58.02	58.02	;	ó ∥ E⊐	Table VII Continued
3.00 INCHES	3.00	2.154 INCHES		29.77 INCHES HG	CECONDADY AVEA	3441037	34075	ø	0	<u>ن</u> ــ	m	•	6	13	5 1	17	****	5	(FT/SEC)	58.11	67.23	14.56	80.17	84.92	86.41	87.35	88.40	89.57	****		0.52,	
ETER: 3.			BETA: 0.70		V	, , , , ,	באי	2.20	1.61	1.03	65.0	0.22	0.10	0.05	0.04	0.04	0.0	ď	(F1/SEC)	174.35	174.22	11.421	174.03	174.11	174.08	174.04	174.06	174.06	174.06	!	$(1) S/D = 0.25, M_U = 0.048$	
UPTAKE DIAMETER:	AREA RATIO, AM/AP:	URIFICE DIAMETERS	CAIFICE BET	AMBIENT PRESSURES	94-96		HES OF MAI	2.20	19.1	1.03	0.59	0.22	0.10	0.05	0.04	0.04	0.0	M.	(LBM/SEC) (LBM/SEC)	0.0	0.034	0.061	0.081	0:099	0.103	0.108	0.112	0.116	******	•	=	
=	Ā		5	ď	40-110			2.60	3.30	3.80	4.20	4.50	4.60	4.70	4.70	4.70	4.70	Z.	(L BM/ SEC.)	0.188	0.188	0.188	0.188	0.188	0.188	0.189	0.188	0.188	0.1 48			
					3	00.4	4:1E 1 1 2	73.0	73.0	73.0	73.0	13.0	13.0	13.0	73.0	73.0	73.0	7+ 1 + A		0.0	0.1700	0.3059	9604.0	1964.0	0.5186	0.5416	0.5608	0.5823	******			
	ËS					140	(DEGREES FAHRENHEIT)	144.0	144.0	144.0	144.0	145.0	145.0	145.0	145.0	145.0	145.0	p*/1*		0.3705	0.2715	0.1739	0.0989	0.0364	0.0169	0.0093	0.0076	0.0068	0.0	R RUN: 10	2.0 2.5	;
-	ER: 1.732 INCHES	9.00 INCHES	3.00 INCHES		í	ž	(366)	144.0	144.0	144.0	144.0	145.0	145.0	145.0	145.0	145.0	145.0	<u>*</u>		0.8824	0.8824	0.8824	0.8824	0.8809	0.8809	0.8809	0.8809	0.8809	0.8809	MIXING STACK PRESSURE DISTRIBUTION FUR RUN:	1.5	
Y NUZZLES:	I AMETER: 1	IGTH: 9.00			i	DPUR	F WATER!	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	*		0-3269	0.2396	0.1535	0.0872	0.0320	0.0149	0.0082	0.0067	0.0000	0.0	SURE DISTR	0:1	
NUMBER OF PRIMAKY NUZ	PRIMARY NOZZLE DIAMET	MIXING STACK LENGTH:	MIXING STACK DIAMETER:	MIXING STACK L/D:		and and	(INCHES OF WATER)	5.6	4-9	6.9	7.3	1.6	7.7	7.7	7.8	7.8	1.8	*	:	0.0	0.1797	0.3233	0.4330	0.5252	0.5484	0.5727	0.5930	0.6157	******	TACK PRESS	0.5	
NUMBER	PRIMAR	MIXING	MIXING	MIXING		~	RUN		2	3	4	S	9		80	. 6	_	z	. N	· -	. ~	ı eri		່ທ	0	~	60	. 6		TXING S	x/0:	
						z	R	7	17	111	٧	u1	v		w	. •	10	-	. 2	-		. [1]	. 4	•		, •	٠.,	. •	10			

DATA TAKEN 19 JULY 77 BY PETE HARRELL

ONE (022LE, NO TRANSITION, STANDOFF 1.00

1/001/2/0/15

MIXING			PRIMARY NOZZLE DIAMETER: 1.732 INCHES	CHES			AREA RATIO, AM/AP:		3.00		
*****	NG STACK LENGTH	ENGTH: 6.	11 6.00 INCHES	,			ORIFICE DI	AMETER: 3	ORIFICE DIAMETER: 2.154 INCHES	s	
MIXIM	MIXING STACK L/D:	// 10: 2.00	ER: 3.00 INCHES 2.00	S			ORIFICE BETA: 0.70 AMBIENT PRESSURE:	ITA! 0.70 ESSURE: 3	29.80 INCHES HG	S HG	
z	POR	DPCR	TOR	TUPT	TAMB	PU-PA	PA-PS	PA-PN2	SECONDARY AREA	AREA	
RUN	(INCHES	OF WATER)	3	(DEGREES FAHRENHEIT)	ENHELT)		(INCHES OF WATER)	TER)	(SQUARE INCHES)	NCHES)	•
~	17.4	15.0	154.0	154.0	74.0	8.40	6.32	6.32	0.0		
7	19.2	15.0	154.0	154.0	14.0	10.20	4.35	4.35	0.785	8. 7.	
۳	20.1	15.0	154.0	154.0	0.45	11.80	2.85	2.85	1.767	29	
4	6.12	15.0	154.0	154.0	74.0	12.90	1.72	1.72	3.142	45	
2	23.0	15.0	154.0	154.0	14.0	14.00	0.65	0.65	6.284	*8	
9	23.4	15.0	154.3	154.0	14.0	14.40	0.31	0.31	9.621	21	
~	23.5	15.0	154.0	154.0	14.0	14.50	91.0	0.16	13.548	E	
89	53.5	15.0	154.0	154.0	14.0	14.60	0.12	0.12	15.512	~	
6	23.6	15.0	154.0	154.0	74.0	14.60	0.10	0.10	17.082	82	
10	23.6	15.0	148.0	148.0	14.0	14.70	0.0	0.0	*****	:	
z	*	* d	*	*1/#d	55° * * 1 *M	7	M.	å	W.	nn	UPT MACE
RUN						(LBM/SEC)	(LBM/SEC)	(F1/SEC)	(FT/SEC)	(FT/SEC)	
	0.0	0.3150	0.8695	0.3623	0.0	0.324	0.0	301-14	100.37	100.37	0.083
7	0.1709	0.2178	0.8696	0.2505	0.1607	0.325	0.055	300.47	115.22	100.15	0.082
m	0.3109	0.1433	0.8696	0.1648	0.2923	0.325	0.101	299.85	127.47	99.94	0.0R2
4	0.4288	0.0867	0.8696	0.0997	0.4033	0.326	0.140	299.48	137.89	99.82	0.082
so.	0.5245	0.0326	0.8696	0.0375	0.4933	0.326	0.171	255.08	146.36	69.55	0.082
9	0.5520	0. CI 54	0.8696	0.0177	0.5191	0.326	0.180	298.94	148.79	99.64	0.082
1	0.5629	0.0081	9698.0	0-0093	0.5294	0.326	0.184	298.90	149.77	99.63	0.082
8	0.5582	1900 " ()	0.8696	0.0010	0.5249	0.326	0.182	298.83	149.32	09.65	0.082
6	0.5610	1500*0	0.8696	0.0058	0.5276	0.326	0.183	298.86	149.59	49.65	0.082
0	****	0.0	0.8782	0.0	*****	0.378	* * * * *	297.33	****	01.66	0.082
HIXING	MIXING STACK PRESSURE		DISTRIBUTION FOR 11918:	OR RUN: 10	_		(a	= Q/S ((a) $S/D = 1.0, M_U$	= 0.082	
:0/x	: 0.3	9.0	1.3		Table	XIII. S	ing]e-Nc	izzle Pe	Single-Nozzle Performance Data for L/D	e Data f	or L/C
PMS(IN. 1120):	0.0	0.0	0.0	0.0		•	4.00	1			
DMCA	0.0	0	0.0			•	otraignt entrance.	Entranc	ູ້		

DATA TAKESI 19 JULY 77 RY PETE HARRELL

ONE NOZZLE, NO TRANSITION, STANDOFF 1.00

1/0/2/100/10

MIXING STACK LENGTH:			C LL		•	AREA KALIO, AM/AP:		3.00		
MIXING STACK DIAMET	# H	: 6.00 INCHES ER: 3.00 INCHES				ORIFICE DIAMETER: Orifice Beta: 0.70	0	2.154 INCHES		
MIXING STACK L/D:	7D: 2-00				•	AMBIENT PRESSURE:		29.80 INCHES HG	94	
POR	OPOR	TOR	TUPT	TAMB	PIJ-PA	PA-PS	PA-PNZ	SECONDARY AREA	AREA	
INCHES	OF WATER)	(DEC	(DECREES FAIRENHELL)	ENHE I)	CINC	(INCHES OF WATER)	ERI	(SQUARE INCHES)	CHES)	
11.5	0.01	150.0	150.0	74.0	5.50	4.20	4.20	0.0		
12.8	10.0	151.0	151.0	14.0	0.70	2.93	2.93	0.785	5	
13.7	10.0	152.0	152.0	74.0	7.70	1.94	1.94	1.767	~	
14.6	10.0	152.0	152.0	14.0	8.50	1.18	1.18	3.142	~	
15.2	10.0	152.0	152.0	74.0	9.20	94.0	0.44	6.284	,e	
15.4	0.01	152.0	152.0	14.0	9.40	0.22	0.22	9.621	-	
15.6	10.0	152.0	152.0	14.0	9.50	0.12	0.12	13.548	œ	
15.6	10.0	152.0	152.0	14.0	09.6	60.0	0.09	15.512	~	
15.6	10:0	152.0	152.0	14.0	09.6	10.0	10.0	17.082	~	
15.7	10.0	146.0	146.0	14.0	9.60	0.0	0.0	***		
*	*	*1	V1/49	55***1.M	3	K S	ď	5	'n	UPT MACY
					(LBM/SEC)	(LBM/SEC) (LBM/SEC) (FT/SEC)	(FT/SEC)	(FT/SEC)	(FT/SEC)	
. 0.0	0.3131	0.8753	0.3577	0.0	0.265	0.0	246.24	85.08	85.08	0.068
0.1719	0.2187	0.8733	0.2502	0.1620	0.265	0.046	246.11	94.39	82.03	0.068
0.3147	0-1449	0.8725	0.1661	0.2964	0.265	0.083	245.98	19.401	81.99	0.068
0.4360	0.0883	0.8725	0.1012	0.4106	0.265	0.116	245.77	113.41	81.92	0.048
0.5291	0.0326	0.8725	0.0374	0.4982	0.265	0.140	245.53	120.12	81.84	0.048
0.5759	0.0165	0.8725	0.0189	0.5424	0.265	651.0	245.47	123.51	81.82	190.0
0.5988	0.0000	0.8725	0.0103	0.5639	0.266	0.159	245.47	125.19	81.82	190.0
0.5770	0.0064	0.8725	0.0073	0.5434	0.266	0.153	245.41	123.59	R1.80	0.067
0.5766	0.0053	0.8725	0,0000	0.5431	0.266	0.153	245.41	123.56	81.80	0.067
*****	,									

C MIXING STACK PRESSURE DISTRIBUTION FUR RIJN: 1.3 0.8 0.3 X/D: PHS(IN. H20):

-0.09

-0.43

- 0.85

.0.11

(b) S/D = 1.0, $M_u = 0.068$ Table XIII. Continued.

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DATA TAKEN 19 JULY 77 BY PETE HARRELL

ONE NOZZLE, NO TRANSITION, STANDOFF 1.00

1/0/2/100/05

The state of the s

		•										UPT MACH		0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
HG	AREA CHES)		v.	~	2	•	_	8	~	2	•	20	(FT/SEC)	58.27	58.23	58.20	58.11	\$8.09	58.08	58.07	58.07	58.03	57.98
3.00 2.154 INCHES 00 29.80 INCHES HG	SECONDARY AREA (SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	****	N	(FI/SEC)	58.27	67.07	14.31	80.28	84.99	86.18	86.04	84.86	85.35	*
`	PA-PNZ Erj	2.13	1.50	96.0	0.59	0.22	0.10	90.0	0.03	0.03	0.0	пр	(FI/SEC)	174.82	174.71	174.60	174.35	174.28	174.26	174.22	174.22	174.10	173.95
AREA RATIO, AN/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIENT PRESSURE:	PA-PS PA	2.13	1.50	96.0	65*0	0.22	01.0	0.05	0.03	0.03	0.0	# S	(LBM/SEC)	0.0	0.033	950.0	0.081	0.099	0.103	0.103	0.098	0.100	****
; 4 G G 4	PU-PA (1MC)	2.70	3.30	3.80	4.30	4.60	4.70	4.80	4.80	4.80	4.80	3	(LBM/SEC)	. 0.187	0.187	0.187	0.188	0.198	961.0	0.188	0.189	0.198	0.138
	TAMB	14.0	14.0	74.0	14.0	14.0	14.0	14.0	74.0	74.0	73.0	N*T**.44		0.0	0.1642	0.2985	9604-0	1965.0	0.5186	0.5164	1454.0	0.5042	***
` <u>\</u>	TUPT TAM	148.0	148.0	148.0	147.0	147.0	141.0	147.0	141.0	146.0	145.0	p*/T*		0.3588	0.2530	0.1655	0.0989	0.0364	0.0169	0.0085	0.0059	0.0051	0.0
ER: 1.732 INCHES 6100 INCHES : 3.00 INCHES	TOR (DEG	148.0	148.0	148.0	147.0	147.0	147.0	147.0	147.0	146.0	145.0	*		0.8782	0.8782	0.8782	0.8797	1618.0	0.8797	0.8797	0.8797	0.8811	0.8826
.T MUZLLES: .IAMETER: 1 .GTH; 6:00 .METER: 3.4	DPOR IF WATER)	5.0	5.0	; vi	5.0	5.0	5.0	5.0	5.0	5.0	2.0	* 6-		0.3751	ú. 2222	0.1.453	0.0870	0.6320	0.0149	9.0074	0.0052	0.0045	0.0
NOTBER OF PRIMARY NO.Z.PRIMARY NO.Z.LE CIAMETI MIXING STACK LENGTH: MIXING STACK DIAMETER: MIXING STACK L/O: 2.	POR DPOR	5.7	4.9	6-9	7.4	7.7	7.8	7.8	7.8	6-1	4-1	ž		0.0	0.1738	0.3161	0.4336	0.5255	0.5487	0.5463	0.5234	0.5331	*****
PRIMAR MIXING MIXING MIXING	KUN	-	2	6	7	٧	•	7.	89	6	. 01	z	RUN		2	rı.	4	50	9	7	63	6	* 01

HIXING STACK PRESSURF DISTRIBUTION FOR RUH: 10 0.0 0.0 0.0 0.0 :0/x

PMSLIN. H20):

(c) S/D = 1.0, $M_u = 0.048$ Table XIII. Continued.

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DATA TAKEN 19 JULY 77 BY PETE HARRELL

													UPT MAC+		0.083	0.082	290.0	0.082	0.082	0.082	0.082	0.082	G. 092	0.082
•	£	AREA ICHES)		5	۲.	<u>ب</u>	*	.	8	2	2	<u>*</u>	3	(FT/SEC)	100.48	100.25	100.14	100.00	99.86	45.89	99.88	99.86	66.86	98.66
	3.00 INCHES 3.00 2.154 INCHES 70 29.80 INCHES HG	SECONDARY AREA (SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	*****	¥	(FI/SEC)	100.48	115.67	128.61	139.20	148.06	150.53	152.22	151.51	152.18	***
	FTER: 3.C AM/AP: 3 METER: 2. A: 0.70 SSURE: 25	PA-PN2 ER1	6.50	4.57	3.06	1.83	69.0	0.33	0.18	0.13	0.11	0.0	ηŊ	(FT/SEC)	301.46	300.76	300.45	300.01	299.60	295.10	299.61	599.59	299.59	299.59
	UPTAKE DIAMFIER: 3.00 I AREA RATIO, AM/AP: 3.00 URIFICE DIAMETER: 2.154 ORIFICE BETA: 0.70 AMBIENT PRESSURE: 29.80	PA-PS PA	6.50	4.57	90-€	1.83	69.0	0.33	0.18	0.13	0.11	0.0	WS	(LBM/SEC)	0.0	0.057	0.105	0.144	0.177	0.187	0.192	0.190	0.192	***
,15	5 4 5 6 4	PU-PA (INC	8.20	10.10	11.60	12.80	13.90	14.30	14.40	14.50	14.50	14.60	d H	(LBM/SEC)	0.323	0.324	0.325	0.525	0.325	0.325	0.325	0.325	0.325	0.325
1/0/2/075/15		TAMB NHEIT)	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	13.0	55***I*M		0.0	0.1648	0.3031	0.4161	0.5104	0.5402	0.5539	0.5466	0.5537	*****
	ęs ·	TUPT TANI (DECRFES FAIRENHEIT)	155.0	155.0	156.0	156.0	156.0	157.0	157.0	157.0	157.0	157.0	P+/1*		0.3724	0.2631	0.1768	0.1060	0.0401	0.0192	0.0102	0.0076	9,0064	0.0
JFF 0.75	1.ES: 1 R: 1.732 INCHES 6.00 INCHES 3.00 INCHES	TOR (DEG	155.0	155.0	156.0	156.0	156.0	157.0	157.0	157.0	157.0	157.0	£		99980	0.8666	0.8652	0.8652	0.8652	0.8638	0.8638	0.8638	0.8638	0.8638
ON, STAMO	TY NOZZLES: DIAMETER: GTH; 6.06 NMETER: 3.	DPOR JF WATER)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	* c		0.3227	0.2280	0.1530	6. 0917	0.0347	0.0166	0.0088	0.0065	0.0055	0.0
NO TRANSIT	NUMBER OF PRIMARY NOZZLES: I PRIMARY NOZZLE DIAMETER: 1.732 INCHES MIXING STACK LENGTH: 6.00 INCHES MIXING STACK DIAMETER: 3.00 INCHES MIXING STACK L/D: 2.00	POR DPOR	17.2	19.1	20.6	21.8	22.4	23.3	23.4	23.4	23.4	23.6	*		0.0	0.1755	0.3230	0.4435	0.5440	0.5762	0.5908	0.5830	0.5905	*****
ONE NOZZLE, NO TRANSITION, STAMOOFF	NUMBE PRIMA MIXIN MIXIN	z a		N	m	4	v	9	-	80	6	10	z	RUN	-	2	e	4	'n	9	7	80	6	01

(d) S/D = 0.75, $M_u = 0.082$ Table XIII. Continued.

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

0.0

0.0

0.0

0.0

X/0: PMS(IN. H2O): PMS*:

41.

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UATA TAKEN 19 JULY 77 BY PETE HARRELL

UNE NULLE, NO TRANSITION, STANDOFF 0.75

1/0/2/015/10

The second secon

							•						UPT MAC-1		890.0	0.068	0.068	0.068	0.068	190.0	0.067	190.0	0.067	0.067
9	IREA	HFS)		10	_	61	•	_	m	~	٨ı	•	an	(FT/SEC)	82.37	87.18	82.07	81.98	81.90	91.87	18.18	81.80	81.80	81.65
3.00 INCHES 3.00 2.154 INCHES '0 29.80 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	2.621	13.548	15.512	17.082	****	¥	(F1/SEC)	82.37	94.88	105.11	114.35	122.69	125.82	127.76	127.08	126.40	* * * *
UPTAKF DIAMETER: 3.00 I AREA RATIO, AM/AP: 3.00 URIFICE DIAMETER: 2.154 ORIFICE BETA: 0.70 AMBIENT PRESSURE: 29.80	PA-PNZ		4.29	3.11	2.01	1.25	0.50	0.25	0.14	0.10	90.0	0.0	ď	(FT/SEC)	247.11	546.54	246.21	245.91	245.73	545.64	245.44	245.41	245.41	244.98
UPTAKF DIAMETER: 3 AREA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0,70 AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	4-29	3.11	2.01	1.25	0.50	0.25	0.14	0.10	0.08	0.0	WS	(LBM/SEC)	0.0	1,0.0	0.085	0.119	0.150	0.161	0.169	0.166	0.164	***
A OR	PU-PA	CINC	5.30	09.9	09-2	8.50	9.20	05.6	9.50	09.6	09.6	9.70	Ţ	(LBM/SEC)	0.254	0.264	995.0	0.265	0.265	0.265	0.265	0.266	0.266	0.266
	TAMB	HEITA	73.0	13.0	73.0	13.0	13.0	13.0	73.0	73.0	73.0	73.0	55°**1*M		0.0	0.1670	0.3018	0.4227	0.5316	0.5724	0.5983	0.5895	0.5806	***
sa sa	TUPT	(DEGREES FAHRENHEIT)	154.0	153.0	153.0	153.0	153.0	153.0	152.0	152.0	152.0	150.0	p*/14		0.3652	0.2655	0.1721	0.1072	0.0425	0.0211	9110-0	0.0036	0.0069	0.0
LES: 1 ER: 1.732 INCHES 6.00 INCHES 1 3.00 INCHES	10k	(DEGR	154.0	153.0	153.0	153.0	153.0	153.0	152.0	152.0	152.0	150.0	<u>*</u>		0.8680	0.8694	0.8694	0.8694	9698.0	0.8694	0.8708	0.8700	0.8708	0.8731
Y NOZZLES: IAMETER: 1 GTH: 6.00 METER: 3.	DPOR	F WATER)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	0.01	ā		0.3170	0.2309	0.1496	0.0932	0.0370	0.0183	0.0101	0.0075	0900.0	0.0
NUMBER OF PRIMARY NOZZLES: PRIMARY NOZZLE DIAMETER: 1. MIXING STACK LENGTH: 6.00 HIXING STACK DIAMETER: 3.(MIXING STACK L/D: 2.00	POR	(INCHES OF WATER)	11.3	12.7	13.6	14.6	15.2	15.5	15.5	15.6	15.6	15.7	ž	į	0-0	0.1776	0.3210	0.4495	0.5654	0.6088	0.6358	0.6265	0.6170	****
NUMBEH PRIMAL MIXING MIXING MIXING	z	KUN :	-	٠ ~	. "	. 4	۰ ۷۰	. •9		. 60		01	2	: 3	<u> </u>	. ~	· (4)	. 4	ۍ ٠	. •9	,	. 00	6	01

MIXING STACK PRESSURE DISTRIBUTION FUR RJN: 10 X/O: 0.3 0.8 1.3 1.8 PHS(IN. HZO): -1.25 -0.74 -0.37 -0.10 PMS*: -0.09 -0.06 -0.03 -0.01

(e) S/D = 0.75, $M_u = 0.068$ Table XIII. Continued.

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DATA TAKEN 19 JULY 77 BY PETE HARRELL

ONE NUZZLE, NO TRANSITION, STANDOFF 0.75

1/0/2/015/05

TAK TAK							COLT OF A DO		00 6		
•	PRIMARY NOZZLE DIAME!	ULAMETEK:	EK: 1.132 INCHES	ES			AKEA KAJIU, AKARI		2.00		
MIXIM	MIXING STACK LENGTH;	Ġ	6.00 INCHES			C	ORIFICE DIAMETER:	# *:	2.154 INCHES		
MIXING	MIXING STACK DIAMETER		3.00 INCHES			0	ORIFICE BETA:	A: 0.70		,	
MIXING	MIXING STACK L/D:	D: 2.00				⋖	AMBIENT PRESSURE:		29.80 INCHES HG	HG	
z	POR	OPUR	10K	1401	TAMB	PU-PA	PA-PS	PA-PN2	SECONDARY AREA	IREA	
RUN	(INCHES	(INCHES OF WATER)	(DEG	(DEGREES FAIRENHEIT)	ENHE I F.)	CINC	(INCHES OF WATER)	ER.)	(SQUARE INCHES)	HES)	
	5.7	5.0	149.0	149.0	73.0	2.70	2.16	2.16	. 0.0		
2	6.2	. 0.8	149.0	149.0	73.0	3.20	1.54	1.54	0.785		
е	6.9	5.0	149.0	149.0	73.0	3.80	1.05	1.05	1.767		
4	1.3	5.0	149.0	149.0	73.0	4-20	0.62	0.62	3-142		
S	7.7	5.0	149.0	149.0	73.0	4.60	0.24	0.24	6.284		
9	1.8	5.0	149.3	0.641	73.0	4.80	0.11	0.11	9.621		
~	1.9	5.0	149.0	149.0	73.0	4.80	90.0	90.0	13.548	_	
8	1.9	5.0	149.3	149.0	73.0	4.80	0.05	0.05	15.512		
6	8.0	5.0	150.0	150.0	73.0	4.80	0.04	0.04	17.082		
01	7.8	5.0	152.0	152.0	73.0	4.70	0.0	0.0	*****		
z	*	r d	*1	*1/*d	55***I*K	A P	S.	ď	¥S	nn	UPT MAC4
RUN						(LBM/SEC)	(LBM/SEC)	(F1/SEC)	(FI/SEC)	(F1/SEC)	
	0.0	0.3184	0.8751	0.3638	0.0	0.187	0.0	174.96	58.32	26.83	0.048
2	0.1765	0.2273	0.8751	0.2597	0.1664	0.187	0.035	174.85	67.22	58.28	0.048
m	0.3277	0.1552	0.8751	0.1773	0.3091	0.187	0.061	174.74	14.89	58.24	0.048
4	0.4458	0.0910	0.8751	0.1039	0.4204	0.187	0.084	114.66	80.90	58.22	0.348
S	0.5509	0.0348	0.8751	0.0398	0.5195	0.188	0.103	174.57	86.26	58.19	0.048
9	0.5770	0.0153	0.8751	0.0186	0.5441	0.188	0.108	174.51	87.58	58.17	0.048
7	0009.0	0.0089	0.8751	0.0102	0.5658	0.188	0.113	174.53	88.17	58.17	0.048
8	0.6271	·0.0074	0.8751	0.0085	0.5913	0.188	0.118	174.53	90.16	58.17	0.048
6	0.6556	0.0067	0.8737	0.0076	0.6178	0.187	0.123	174.69	51.64	58.23	0.048

HIXING STACK PRESSURE DISTRIBUTION FUR RUN: 10
X/U: 0.3 0.8 1.3 1.8
PHS(IN. H2U): 0.0 0.0 0.0 0.0
PHS*: 0.0 0.0 0.0

(f) S/D = 0.75, $M_u = 0.048$ Table XIII. Continued. 0.0 0.0

DATA TAKEN 19 JULY 77 BY PETE HARRELL

	UPTAKE DIAMETER: 3.00 INCHES	AREA RATIO, AM/AP: 3.00	ORIFICE DIAMETER: 2.154 INCHES	ORIFICE BETA: 0.70	AMBIENT PRESSURE: 29.79 INCHES HG
1/0/5/02/15					
ONE NOZZLE, NO TRANSITIOM, STANDOFF 0.50	NUMBER OF PRIMARY HOZZLES: 1	PRIMARY NOZZLE DIANETER: 1.732 INCHES	MIXING STACK LENGTH: 6.00 INCHES	MIXING STACK DIAMETER: 3.00 INCHES	MIXING STACK L/D: 2.00

												UPT MAC4		0.083	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
AREA	CHES)		w	7	2	4		8	2	2	*	3	(FT/SEC)	100.11	18.66	99.95	18.96	99.45	99.44	14.06	84.66	05.55	90.66
SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3-142	6.284	9.621	13.548	15.512	17.082	*****	5	(FT/SEC)	10001	114.49	126.34	136.08	143.55	145.72	146.34	146.01	146.85	*****
PA-PNZ	ER.)	00*9	4.08	29.2	1 - 56	0.58	0.27	0.14	0.11	0.09	0.0	ď	(LBM/SEC) (FT/SEC)	300.34	599.64	299.86	299.46	298.36	298.32	258.25	298.46	298.22	297.20
PA-PS	(INCHES OF WATER)	00-9	4.08	29.2	1.56	0.58	0.27	0.14	0.11	0.09	0.0	MS	(LBM/SEC)	0.0	0.054	160.0	0.133	191.0	0.169	0.172	0.170	0.174	*****
PU-PA	CINC	A. 70	10.60	12.00	13.10	14.10	14.30	14-40	14.50	14.50	14.60	Z.	(LBM/SEC)	0.325	0.325	0.325	0.326	0.327	0.327	0.327	0.327	0.327	0.328
TAMB	NHELT)	14.0	14.0	74.0	14.0	14.0	14.0	14.0	74.0	14.0	14.0	55" + * J *M		0.0	0.1555	0.2802	0.3840	0.4655	0.4882	0.4951	0.4909	0.5004	*******
TUPT	(DEGREFS FAHRFNHELT)	151.0	151.0	154.0	154.0	151.0	151.0	151.0	152.0	151.0	147.0	P*/1*		0.3442	0.2351	0.1515	0.0905	0.0334	0.0157	0.0081	0.0061	0.0052	0.0
10R		151.0	151.0	154.0	154.0	151.0	151.0	151.0	152.0	151.0	147.0	*		0.8739			0.8696	0.8739	0.8739	0.8739	0.8725	0.8739	0.8797
DPOR	JF WATER	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	. 0-51	15.0	*		0.3008	0.2055	0.1318	0.0787	0.0292	0.0137	0.0071	0.0053	9500-0	0.0
POR	(INCHES (17.7	19.6	21.0	22.1	23.1	23.4	2 j.4	23.5	23.5	23.6	*d		0.0	0.1651	0.2980	0.4083	0.4940	0.5181	6.5253	0.5213	0.5310	****
z	RUN	-	8	m	4	'n	•	٠	89	6	10	z	RUN	1	8	m	4	ĸ	9	7	8	ø	01

HIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10

X/0: 0.3 0.8 1.3 1.0

PMS(IN. H2O): 0.0 0.0 0.0 0.0

PMS+: 0.0 0.0 0.0 0.0

(g) S/D = 0.50, $M_u = 0.082$ Table XIII. Continued.

DATA TAKEN 19 JULY 77 eY PETE HARRELL

												UPT MACH		0.068	0.068	0.068	0.068	0.048	0.068	0.068	0.067	0.067	. 0.067
94	AREA CHES)		2	~	~	*	-	80	~		•	Ð	(F 1/SEC)	81.95	81.81	81.98	81.92	81.86	81.84	81.83	81.81	81.54	81.33
3.00 INCHES : 3.00 2.154 INCHES 70 29.79 INCHES HG	SECONDARY AREA (SQUARE INCHES)	0.0	0.785	1.767	3-145	6.284	9.621	13.548	15.512	17.082	****	¥	(FT/SEC)	81.95	93.74	103.77	111.77	118.11	121.09	123.36	123.61	123.36	*****
ETER: 3.0 AM/AP: 3 HETER: 2. A: 0.70 SSURE: 29	PA-PNZ Er)	4.08	2.12	1.79	1.06	0.39	0.20	0.11	60.0	0.07	0.0	d D	(FT/SEC)	245.45	245.46	245.96	245.78	245.60	245.54	245.51	245.45	544.64	244.01
UPTAKE DIAMETER: 3 AREA RATIO, AH/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 A4BIENT PRESSURE:	PA-PS PA-	4.08	2.72	1.79	1.06	0.39	0.20	0.11	60.0	0.07	0.0	S.	(L.BM/SEC)	0.0	0.044	0.080	0.110	0.135	0-144	0.152	0.153	0.153	******
5 8 5 5 4	PU-PA (INC	6-70	06.9	7.90	8.60	02.6	04.6	9.50	09.6	09.6	9.70	3	(LBM/SEC)	0.265	0.266	0.265	0.265	0.265	0.265	0.265	0.265	0.266	0.267
	TAMB	74.0	14.0	74.0	74.0	14.0	74.0	14.0	14.0	74.0	74.0	55 ** 1 *M	,	0.0	0.1560	0.2846	0.3891	0.4717	0.5106	0.5399	0.5434	0.5428	******
81	TUPT TAM (DEGREES FAHRENHEIT)	148.0	148.0	152.0	152.0	152.0	152.0	152.0	152.0	148.0	145.0	*J/*d		0.3476	0.2325	0.1534	6050*0	0.0335	0.0168	9600.0	0.0073	0900-0	0.0
LLES: 1 ER: 1.732 INCHES 6.00.INCHES : 3.00 INCHES	1.0R (DEG	148.0	148.0	152.0	152.0	152.0	152.0	152.0	152.0	148.0	145.0	<u>*</u>		0.8782	0.8782	0.8725	0.8725	0.8725	0.8725	0.8725	0.8725	0.8782	0.8826
Y NOZZLES: 11 AMETER: 1 16TH: 6.00 MF1ER: 3.	DFOR F 3.ATER)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	0.01	10.0	* č		0.3053	0.2042	0.1338	0.0794	0.0292	0.0146	0.0083	0.0064	0.0053	0.0
NUMBER OF PRIMARY NOZZLES: PRIMARY NOZZLE DIAMETER: 1.7 MIXING STACK LENGTH: 6.00.7 MIXING STACK L/O: 2.00	POR OFOR	11.6	12.9	13.9	14.7	15.3	15.5	15.6	15.6	15.6	15.7	*		0.0	0.1652	0.3022	0.4132	0.5009	0.5421	0.5733	0.5770	0.5748	******
NUMBER PRIMAF MIXING MIXING	z Z	-	7	m	÷	Ŋ	9		80	·	10	z	KUN	-	2	ю	4	w	٠	7	80	6	10

MIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10 1.3 0.8 X/D: 0.3 PMS(IN. H2O): .-1.46 PMS*: -0.11

0.13

(h) S/D = 0.50, $M_{\rm u}$ = 0.068 Table XIII. Continued.

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													UPT MACH		0.048	0.048	0.048	0.048	0.048	0.048	6,000	0.048	0.048	0.048
	нс	AREA CHES 3		ın		~	.		œ	2	2		2	(FT/SEC)	58.28	58.28	58.25	58.07	58.05	58.05	58.03	58.18	58.18	51.54
	3.00 INCHES : 3.00 2.154 INCHES 10 29.79 INCHES HG	SECONDARY AREA (SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	*****	¥.	(FT/StC)	58.28	66.88	13.11	79.18	83.68	85.44	86.02	86.82	87.68	* * * * *
	ETER: 3.0 AM/AP: 3 METER: 2.4 A: 0.70 SSURE: 25	PA-PNZ ER J	5.04	1.42	16.0	0.53	0.20	0.10	0.05	0.04	60.03	0.0	d.	(FT/SEC)	174.84	174.86	114.75	174-23	174-17	174.15	11.4.11	114.56	174.56	173.84
	UPTAKE DIAMETER: 3 AREA RATIO, AM/AP: ORIFICE DIAMETER: URIFICE BETA: 0.70 AMBIENT PRESSURE:	PA-PS PA (INCHES OF WATER)	2.04	1.42	16.0	65.0	0.20	01.0	0.05	0.04	0.03	0.0	ĸ	(LBM/SEC) (FT/SEC)	0.0	0.032	0.057	0.077	0.094	001.0	0.103	0.105	0.108	****
35	U AK OR OR	PU-PA (1NCH	2.80	3.40	3.90	4.30	09*4	4.70	4.80	4.80	4.80	4.80	à	(L.BH/SEC)	0.187	0.187	2.187	0.188	0.168	0.138	0.188	0.188	0.188	0.189
1/0/2/050/05		6	74.0	14.0	0.47	14.0	74.0	74.0	74.0	74.0	74.0	14.0	75"+* I +H		0.0	0.1597	0.2877	0066.0	0.4730	0.5054	0.5163	9.5289	0.5448	****
	x i	TUP! TAMENHEIT)	146.0	149.0	149.0	146.0	146.0	146.0	146.0	149.0	149.0	0.441	P*/I*		0.3436	0.2395	0.1537	9680.0	0.0330	1910.0	0.0085	8900.0	0.0059	0.0
FF 0.50	LES: 1 R: 1.732 INCHE 6.00 INCHES 3.00 INCHES	TOR	148.0	149.0	149.0	146.0	146.0	146.0	146.0	149.0	149.0	144.0	÷		0.8782	0.8768	0.8768	0.8811	0.8811	0.8811	0.8811	0.8758	0.8768	0.8840
ION, STANDOFF	3 2 3	POR DPOR	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	9.0	ŧ		0.3018	0.2100	0.1348	0.0789	0.0291	0.0142	0.0075	0.0059	0.0052	0.0
NO TRANSIT	NUMBER OF PRIMARY NOZZI PKIMARY NOZZLE DIAMETEI MIXING STACK LENGTH; MIXING STACK DIAMETER; MIXING STACK L/D; 2.	POR	5.9	6.5	7.0	7.4	1.1	7.8	7.8	7.9	6.7	1.9	*		0.0	0.1692	0.3048	0.4124	0.5001	0.5343	0.5459	0.5604	0.5772	****
GNE NOZZLE, NO TRANSITION, ST	NUMBE PKIMA MIXIM MIXIM	Z 3	1	8	m	4	'n	9	~	89	٥	01	z	RUN		~	m	4	Ś	۰.		Φ	٥	01

MIXING STACK PRESSURE DISTRIBUTION FOR-RUN: 10 0.0 0.0 0.0 0.0 X/D: PMS(IN. H2O): PMS*:

(i) S/D = 0.50, $M_u = 0.048$ Table XIII. Continued.

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TAKEN
AT AC

ONE NUZZLE, NO TRANSITION, STANDOFF 0.25

1/0/2/025/15

			116	REA	неѕ)											UU JPT MACH	(FT/SEC)	100.37 0.083	100.23 0.082	100.07 0.082	99.96 0.082	95.87 0.082	99.95 0.082	280.67 0.082	39.67 0.082	99.59 0.082
5 mout 00 s	3.00 7.154 INCHES		29.79 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	15.512	17.082	******	5	(FT/SEC)	100.37	114.22	124.55	132.70	138.87	140.24	140.31	140.29	139.92
		A: 0.70	SSURë: 2	PA-PNZ	ER J	5.58	3.74	2.25	1.27	0.45	0.21	0.11	0.08	10.0	0.0	ď	(FI/SEC)	301.14	300.72	300.24	16.665	29.662	299.86	20.662	299.02	298.78
ADEA DATED ALLAS	AREA KAILU, AM/AP: ORIFICE DIAMETER:	ORIFICE BETA: 0.70	AMBIENI PRESSURE:	PA-PS	(INCHES OF WATER)	5.58	3.74	52.5	1.27	0.45	0.21	0.11	0.08	10.0	0.0	S M	(LBM/SEC)	0.0	0.051	0.000	0.120	0.143	0.147	0.149	0.148	0.147
. •	₹ ₹	5 5	¥	PU-PA	CINC	9.20	11.00	12.30	13.30	14.00	14.10	14.30	14.30	14.30	14.00	ž	(LBM/SEC)	0.324	0.324	0.325	0.325	0.325	0.325	926.0	0.326	0.326
				TAMB	NHE I I I	75.0	15.0	15.0	15.0	15.0	15.0	75.0	15.0	75.0	75.0	75***1*M		0.0	0.1489	0.2596	0.3463	0.4120	0.4257	0.4289	0.4286	0.4254
	£			TUPT	(DEGREES FAIMENHEIT)	155.0	156.0	156.0	156.0	156.0	157.6	154.0	154.0	153.0	152.0	*1/*d		0.3205	0.2158	20€1.0	0.0737	0.0262	0.0119	1900.0	0.0047	0.0038
233 147465	6-00 INCHES	3.00 INCHES		108	(DEG	155.0	156.0	156.0	156.0	156.0	157.0	154.0	154.0	153.0	152.0	*		0.8698	0.8684	9898-0	0.8684	0.8684	. 3570	0.8713	0.8713	0.8727
TAMETER.	MGTH: 6.00	•	•	DPOR	JF WATER!	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	ŧ		0.2788	0.1874	0.1131	0.0640	0.0227	0, 6103	0.3053	0.0041	0.0033
DOLLARDY MITTIE DIAMETER:	PRIBARI MOZZLE DIAME MIXING STACK LENGTH:	MIXING STACK DIAMETER:	G STACK L/D:	POR	(INCHES OF WAT	18.2	20.0	21.3	22.4	23.0	23.2	23.3	23.3	23.3	22.9	*		0.0	0.1584	0.2762	0.3685	0.4384	0.4533	6 4557	0.4554	0.4517
3	MIXIN	NIXIN	MIXING	z	RUN	1	7	۰.	4	s	•	1	89	6	10	z	RUN		2	m		v	•	1	80	6

HIXING STACK PRESSURE DISTRIBUTION FOR RUN: 10
X/O: 0.3 0.8 1.3 1.8
PMS(IN. H2O1: 0.0 0.0 0.0 0.0
PMS*: 0.0 0.0 0.0 0.0

(j) S/D = 0.25, $M_u = 0.082$ Table XIII. Continued.

DATA TAKEN 19 JULY 77 BY PETE HARRELL

ONE NOZZLE, NO TRANSITION, STANDOFF 0.25 1/0/2/025/10

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AMBIENT PRESSURE: 29.79 INCHES HG ORIFICE DIAMETER: 2.154 INCHES UPTAKE DIAMETER: 3.00 INCHES AREA RATIO, AM/AP: 3.00 ORIFICE BETA: 0.70 PRIMARY NUZZLE DIAMETER: 1.732 INCHES MIXING STACK DIAMETER: 3.00 INCHES MIXING STACK LENGTH; 6.00 INCHES NUMBER OF PRIMARY NOZZLES: MIXING STACK L/D: 2.00

UPT MACH 0.068 990.0 0.068 0.068 0.068 0.068 0.060 0.068 82.04 81.99 81.93 81.90 R1.91 81.35 82.21 16.18 (SQUARE INCHES) SECONDARY AREA 0.785 1-767 3.142 6.284 13.548 17.082 9.621 ****** 15.512 (FT/SEC) 82.32 102.33 109.13 119.49 93.70 115.55 117.48 117.04 117.22 ***** (LBM/SEC) (FT/SEC) 246.13 245.74 PA-PNZ 246.97 245.98 245.80 245.74 246.63 245.71 245.74 244.07 2.53 1.55 0.88 0.34 0.16 0.09 90.0 0.05 0.0 (INCHES OF WATER) 0.099 0.042 0.123 0.074 0.130 0.138 0.129 ****** 0.0 PA-PS 7.53 1.55 0.88 0.34 91.0 0.09 90.0 0.05 0.0 (LBM/SEC) 0.265 0.264 0.265 0.265 0.265 0.265 0.265 0.267 0.264 0.265 05.6 04.6 04.6 9.50 9.00 7.10 8.10 09.8 9.20 9.40 441*W 0.4566 0.1505 0.2648 0.3535 0.4372 0.4625 0.4590 0.4884 ****** 75.0 75.0 75.0 75.0 75.0 75.0 (DEGREES FAHRENHEIT) 0.0052 0.1328 0.2163 0.0288 0.0138 0.0043 154.0 153.0 *1/*d 0.3223 0.0751 0.0077 154.0 153.0 153.0 153.0 153.0 145.0 153.0 153.0 0.0 0.8713 0.8727 0.8727 0.8727 0.8713 0.8727 0.8727 0.8727 0.8727 154.0 153.0 153.0 153.0 153.0 153.0 153.0 145.0 153.0 INCHES OF WATER! 0.0045 0.2808 0.1159 8900.0 0.1884 0.0655 0.0251 0.0120 0.0038 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 0.0 0.4642 0.5186 0.4874 0.4911 0.1599 0.3754 0.4848 0.2811 12.1 13.2 14.2 14.7 15.3 15.4 15.5 15.5 0.0 S S S

MIXING STACK PRESSURE DISTRIBUTION FOR KUN: 10

X/0: 0.3 0.8 1.3 1.6 PMS(IN. H20): -1.37 -6.93 -0.55 -0.12 PMS*: -0.10 -0.07 -0.04 -0.01

(k) S/D = 0.25, $M_u = 0.068$ Table XIII. Continued.

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DATA TAKEN 19 JULY 77 BY PETE HARRELL

ONE NOZZLE, NO TRANSITIUN, STANDOFF 0.25

1/0/2/025/05

HIXING STACK LENGTH: HIXING STACK DIAMETER MIXING STACK L/D: N PUR DPOR TO CINCHES OF WAT	STACK			TER: 1.732 INCHES		•	AREA RATIO, AM/AP:		3.00		
HIXING HIXING NIXING NI			6.00 INCHES			J	ORIFICE DIAMETER:		2.154 INCHES		
2	STACK D.	HIXING STACK DIAHETER: 3	3.00 INCHES			•	ORIFICE UFTA: 0.70	A: 0.70			
RUN'	MIXING STACK L/D:	/D: 2.00				*	AMBIENT PRESSURE:		29.79 INCHES HG	911	•
RUN '	PUR	DPOR	10R	TUPI	1 AMB	PU-PA	PA-PS	PA-PHZ	SECONDARY ARFA	ARFA	
	UNCHES OF WAT	OF WATEK)	1060	(DEGREES FAIRENIELT)	ENIRE I T.)	CINC	(INCHES OF WATER)	ER)	(SQUARE INCHES)	CHES!	
•	6.1	5.0	150.0	150.0	75.0	3.00	1.94	1.94	0.0		
2	9.9	5.0	150.0	150.0	75.0	3.50	1.30	1.30	. 0.785	S	
3	7.1	5.0	150.0	150.0	75.0	4-00	0.19	52.0	1.767	4	
4	7.5	5.0	150.0	150.0	15.0	05-5	0.45	0.45	3.142	2	
2	1.7	5.0	150.0	150.0	75.0	09-4	0.16	91.0	6.284	4	
ť	1.8	5.0	150.0	150.0	75.0	4.70	0.07	0.07	9.621	***	
7	7.8	5.0	150.0	150.0	75.0	4.70	0.03	0.03	13.548	80	
89	5.1	5.0	150.0	150.0	75.0	4.70	0.03	0.03	15.512	~	
٥	1.9	5.0	151.0	151.0	75.0	4.80	60.0	0.03	17.082	2	
01	7.8	5.0	149.0	149.0	75.0	4.70	0.0	0.0	****	#	
z	*	¥ d	*	p*/1¢	77.**I*H	Š	ĸ	å	¥	ñ	UPT MACH
RUN			•			(L BM/ SEC)	(LBM/SEC)	(FT/SEC)	(FT/SEC)	(FI/SEC)	
	0.0	0.2867	0.8770	0.3269	0.0	0.187	0.0	175.09	58.36	58.36	0.048
8	6191-0	0.1924	0.8770	0.2193	0.1528	0.187	0.030	174.98	95.99	58.32	0.048
	0.2830	0.1163	0.8770	0.1326	0.2671	0.187	0.053	174.87	12.71	58.29	0.048
4	0.3787	0990.0	0.8770	0.0752	0.3575	0.187	0.071	174.79	77.59	58.26	0.048
ι N	0.4469	0.0230	0.8770	0.0262	0.4218	0.187	0.084	174.14	80.18	58.24	0.048
9	0.4598	0.0104	0.8770	0.0118	0.4340	0.187	0.086	174.72	81.74	58.24	0.048
	0.4578	0.0052	0.870	0.0059	0.4321	0.187	0.086	174.72	81.64	58.24	0.048
8	0.4429	0.0037	0.8770	0.0042	0.4181	9.187	0.093	174.74	80.89	58.24	0.048
0	0.4882	0.0037	0.8755	0.3042	0-4604	0.187	0.091	174.04	83.21	58.28	0.048
01	******	0.0	0.8784	0.0	******	0.188	******	174.58	*****	58.19	0.048

C MIXING STACK PRESSURE DISTRIBUTION FOR RUN:

(1) S/D = 0.25, M_u = 0.048 Table XIII. Continued. 0.0 0.0 0.0 0.0 X/D: , PMS(IN. H20): PMS*:

DATA TAKEN 28 JIMY 77 BY PËTE HARRELL

4/1/7.57/050/10
0.50
STANDOFF 0
TRANSITION.
ELL IPTIC
NOZZLES.
FOUR

PRIMARY MOZZLE DIAMETER: 0 MIXING STACK LENGTH: 22-71 MIXING STACK DIAMETER: 3-4 MIXING STACK OLAMETER: 3-4	DIAMETER: 0.866 IPA NGTH; 22.71 INCHES	ETER: 0.866 INCHES	S		AF	AREA RATIO, AM/AP:		3.00		
NG STACK LEING STACK OLV	NGTH: 22.71									
ING STACK OLU		LINCHES			ຮ້	ORIFICE DYAMETER:		2.154 INCHES		
TAC CTACK 17	METER: 3.	ER: 3.00 INCHES			20.	ORIFICE BETA: 0.79	R: 0.79			
THE STREET	1.57				¥	AMBIENT PRESSURE:		29.91 INCHES HG	ЭН	
80	DPOR	TOR	TUPT	TAMB	₽U-PA	PA-PS	PA-PN2	SECENDARY AREA	RE.▶	
(INCHES ((INCHES OF WATER)	(DEGF	(DEGREES FAHRENHEIT)	ENHEITI	(19)	CINCHES OF WATER	ERB	(SQJARE INCHES)	HES)	
12.7	10.0	151.0	151.0	72.0	6.70	4.83	4.83	0.0		
13.8	10.0	151.0	151.0	73.0	7.80	3.74	3.74	0.785		
15.0	10.0	151.0	151.0	73.0	6.00	2.59	2.59	1.767		
15.9	0.01	0.151	151.0	73.0	06*5	1.64	1.64	3.142		
17.0	10.0	151.0	151.0	13.0	11.00	19.0	19.0	6.284		
17.3	10.0	151.0	151.0	73.0	11.30	0.33	0.33	5.621		
17.5	0.01	152.0	152.0	73.0	11.40	0.18	0.18	13.548		
17.6	10.0	151.0	151.0	73.0	11.50	0.12	0.12	17.081		
17.6	10.0	150.0	150.0	73.0	11.60	0.0	0.0	***		
•	. å	• •	P4/T4	N*T * * . 4 4	a a	NS	å	HC.	3	UPT MACH
•	•	•	•		(LBM/SEC)	(LBM/SEC)	(FT/SFC)	(FT/SEC)	(FT/SEC)	
0.0	0.3401	0.8723	3.3899	0.0	0.265	0.0	252.68	84.22	84.22	0.070
0.1942	0.2641	0.8723	0.3027	0.1828	0.266	0.052	252.32	98.21	84.10	0.069
0.3632	0.1834	0.8723	0.2103	0.3420	0.266	0.097	251.96	110.42	85°E8	0.069
6.11.33	0.1164	0.8723	3.1335	0.4834	0.266	0.137	251.64	121.28	62.88	0.069
0.6529	0.0473	0.8723	0.0542	0.6148	0.267	0.174	251.36	131.42	83.78	0.069
0.7039	0.0235	0.8723	9.0269	0.6628	0.267	0.189	251.25	135.12	93.74	0.069
0.7326	0.0128	0.8708	0.0147	0.6893	0.267	0.195	251.39	137.22	£3.79	0.069
0.7533	0.0085	0.8723	0.0098	0.7094	0.267	0.201	251.20	138.73	83.73	0.069
4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	,	1	,			*****	260.03	*****	83.64	0.069

				0.0	
	9.6	0	•	0.0	0
	4 - 5	0.0	0.0	0.0	0.0
	4.0	0.0	0.0	0.0	0.0
	3.5	0.0	0.0	0.0	0.0
	3.0	0.0	0.0	0.0	0.0
	2.5	0.0	0.0	0.0	0.0
6 ::	2.9	0.0	0.0	0.0	0.0
FOR PUM:	1.5	0.0	0.0	0.0	0.0
PRESSURE DISTRIBUTIONS	1.0	0.0	0.0	0.0	0.0
URE DIS				0.0	
K PRESS	0.0	0.0	0.0	0.0	0.0
MIXING STACK	:0/x	PHS A(IN. H20):	PMS* A:	PMS B(IN. H20):	PMS+ B:

0.0

(a) S/D = 0.50

Table XIV. Four-Nozzle Performance Data for L/D = 7.57, $M_{\rm U}$ = 0.068, Elliptic Transition.

DATA TAKEN 28 JULY 77 BY PETE HARRELL

													UPT MACH		0.070	0.069	0.069	0.069	0.069	0.065	690.0	0.069	0.069	0	. ·
	# £	re.	HES)		41	~	01	·P		a		•	ລຸດ	(FT/SEC)	64.32	84-12	65.99	83.56	83.78	83.81	83.72	43.79	83.43	4	
	3.00 INCHES 2.00 2.154 INCHES 9 25.91 INCHES HG	SECONDARY AFEA	(SOLIARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	17.061	****	5	(FT/SEC)	84.32	98.42	110.88	122.15	132.30	135.96	137.15	137.63	* * * *		0.0
	25 25	-PNZ		2.00	3.84	2.68	1.71	69.0	0.34	0.18	0.12	0.0	ď	(FT/SEC)	252.96	252.39	251.99	251.89	251.35	251.46	251.18	251.38	250.31		4.0
	UPTAKE DIAMETER: 3 AREA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	5.00	3.84	2.68	1.71	69.0	0.34	0.18	C-12	0.0	MS	(LBM/SEC)	0.0	0.052	0.098	0-110	0.177	161.0	961.0	0.197	*****		3.5
25/10	J & D O A	Pts-PA	(INC)	(;-50	7.70	8.90	6 -8 0	10.80	11.20	11.40	11.40	11.60	d x	(LBM/SEC)	0.265	0.266	0.266	0.266	0.267	0.267	0.267	0.267	0.268		3.0
4/1/7.57/025/10		TAMR	WHEIT)	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	55" ** L*M		0.0	0.1852	0.3479	0.4936	0.6263	0.6729	6.6893	9,69.0	******		2-31
3.25	V	TUPT	(DEGREES FAHRENHEIT)	152.0	151.0	151.0	152.0	151.0	152.0	151.0	152.9	147.0	p*/T*		9.4334	0.3107	0.2175	0.1391	0.0563	3.0278	9.0147	9633° 9	0.0	OF PORTS	1.5 2.0
TION. STANDAFF 3.25	7LES: 4 EB; 0.866 INCHES 22.71 INCHES : 3.00 INCHES	TOR	(DEC	152.0	151.0	151.0	152.0	151.0	152.0	151.0	152.0	147.0	<u>*</u>		0.8708	0.8723	0.8723	6.8708	0.8723	0.8708	0.8723	C.8708	0.8780	DISTRIBUTIONS FOR PURE	1.0
	IY NOZZLES: CIAMETER: (GTH: 22-7) NHËTER: 3.	DPOR	(INCHES OF MATER)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	0.01	å.		0.3513	0.2710	0.1897	0.1212	0.0491	0.0242	0.0128	0.0082	0.0		0.5
. ELLIPTIC	NUMBER OF PRIMARY NOZZLES: PRIMARY NOZZLE CIAMETER; O MIXING STACK LENGTH; 22-71 MIXING STACK DIAMĖTER; 3- MIXING STACK L/D: 7-57	POR	(INCHES (12.6	13.8	14.9	15.9	16.9	17.3	17.4	17.5	17.6	*	1	0.0	1961.0	9696.0	0.5246	0.6651	1511.0	0.7320	0.7382	******	MIXING STACK PRESSURE	x/D: 0.0
FOUR NOZZLES. ELLIPTIC TRANSI	NUMBE PRIMA HIXIN MIXIN	z	RUN		. 2	m	4	· w	. •	1	. 33	6	2	2 2	-	· ~i	ı M	• •	ĸ	9	7	c	6	MIXING	

0.175 3.175 0.013 0.013 0.016 0.215 0.015 0.220 (b) S/0 = 0.250.015 0.215 0.220 0.016 0.195 0.205 0.015 0.014 0.115 0.010 0.008 0.135 0.075 0.030 0.005 0.002 -0.009 -0.185 -0.120 -0.013 -0.550 -0.039 -0.500 -0.036

PMS A(IN. H20): -0.940

PMS* A: -0.067

PMS B(IN. H2D1: -0.925

PMS* 8: -0.066

Table XIV. Continued.

0.035 0.003 0.040

0.045

0.130 500.0 0.125

3.125 0.00

0.003 C.050 0.004

C. 130 0.009

0.009

DATA TAKEN 29 JULY 77 BY PETE HARRELL

FOUR NUZZLES. ELLIPTIC TRANSITION. STANDSF 3.3

	NUMBER OF PRIMARY MOZZLES:	HARY NOZZLI	ES: 4				_	UPTAKE DĮAMĘTER:	AMET ER:	3.30 INCHES	CHES		
	PRIMARY NOZZLE CIAMETER: 0.866 INCHES	E CIAMETER	. 0.866	INCHES				AREA SAT'O, AM/AP:	O. AM/AP	3.00			
	HIXING STACK LENGTHE		22.71 INCHES	s:				ORIFICE DIAMETER:	1 AMETER:	2.154 !NCHES	THCHES		
	MIXING STACK DIAMETERS	DIAMETERS	3.0C INCHES	HES			J	OKIFICE BETA:	ETA: 9.79	2			
	MIXING STACK L/D:	1.57	4				7	AMBIENT PRESSURE:	P.ESSURE:	29.75	29.75 TNCHES HG	1 6	
	POR	DPOR	100	J.	TUPT	TAMB	PU-PA	PA-PS	PA-PNZ		SECONDARY APEA	6.	
œ	RUN (INCHE	(INCHES OF MATER)		(DEGREES FAHRENHETT)	FAHRENH	ETT)	ON I	(INCHES OF WOTER)	(TER)	1500	(SQUARE INCHES)	HES)	
	2 13.6	10.0	149.0	148.0	••	75.0	7.60	3.93	3.93		0.785		
	1 12.5	10.0	148.0	148.0	••0	15.0	6.40	5.16	5.16		0.0		
	3 14.9	10.0	148.0	148.0	0.	15.0	8.80	2.12	5.72		1.767		
	4 15.8	10.0	148.0	148.0	0	75.0	9.80	1.11	1.17		3.142		
-	5 16.9	10.0	148.0	148.0	0.	15.0	10.80	97.0	0.74		6.284		
	17.1	10.0	148.0	148.0	0.	15.0	11.10	0.38	0.38		9.621		
	1 17.2	10.0	148.0	148.0	•	75.0	11.20	0.22	0.22		13.548		•
-	8 17.3	10.0	148.3	146.0	0.	75.0	11.30	0.15	0.15		17.061		
	9 17.5	10.0	145.0	145.0	0.	15.0	11.40	0.0	0.0	***	****		
_	ž	*d	2	*1/*d		55"**I*H	æ	ž	ŝ	***	Ŧ	3	UPT MACH
æ	RUN						(LBM/SEC)	(LBM/SEC)	C) (FT/SFC)		(FT/SEC) ((FT/SEC)	
	1 0.0	0.3660	0.8799	•	0.4159	0.0	0.265	0.0	252.92		84.30	84.30	9.579
-	2 0.1982	0.2797	0.8799		0.3179	0.1873	0.266	0.053	252.47		89.86	84.15	0.000
•	3 0.3706	3.1942	0.8799		0.2207	0.3503	0.266	0.099	252.10	111.24	.24	84.03	0.07
٠	4 0.5310	0.1267	0.8799		0.1440	0.5119	0.266	0.141	251.78	122.96	96	£3.92	0.069
	5 0.6857	0.0531	0.8759	60 0.0603		0.6482	0.267	0.183	251.47	134.30	.30	83.82	0.069
•	6 0.7522	0.0273	0.8799	0150.0 60		0.7113	0.267	0.201	251.30	139.14	.14	83.76	690.0
	9961.0 7	0.0155	0.8799	9710.0 9		0.7530	0.267	0.212	251.23	142.40	.40	83.74	0.069
_	0.8247	0.0104	0.8799	9 0.0113		0.7795	0.267	0.220	251.21	144-41	.41	83.73	0.069
•	******	0.0	0.8842	2 0.0		******	0.267	***	259.56	*****	*	83.52	690.0
_	MIXENG STACK PRESSURE DISTRIBUTIONS FOR RIME	ESSURE DIST	RIBUTION	S FOR RH	o 								
	x/0: 0.0	0.5	1.0	1.5		2.5	3.0	3.5	6-4	6.5	5.0	5.5	0.9
MS A	PMS A(IN. H20): -1.200	00 -0.725	-0.290	-0.040	0.075	0.173	0.205	3.205	5	9.115	0.130	0.043	0.030
	PHS* A: -0.087	87 -0.052	-0.021	-0.003	0.005	0.012	0.015	0.015	0.012	0.008	500.0	0.003	0.002
MS B	PMS B(IN. H20): -1.180	80 -0.810	-0.405	-0.125	0.040	0.150	0.190	0.200	0.165	G. 120	0.135	C.045	0.025
	PMS* 8: -0.085	85 -0.059	-0.029	-0.099	0.003	0.911	0.014	0.014	0.012	600.0	0.010	0.003	0.002
						(0)	c .						

(c) S/D = 0.0Table XIV. Continued.

DATA TAKEN 28 JULY 77 BY PETE HARRELL

													UPT MACH		0.010	0.069	0.069	690.0	0.069	596*0	690.0	0.069	3.069
	9	REA	1601							-	_			(FT/SEC)	84.33	84.14	90*+3	63.89	83.82	83.77	83.69	83.75	83.46
	3.00 THCHES 3.00 2.154 INCHES 0 29-91 INCHES HG	SECONDARY AREA	ISUUA'E INC	0.0	0.765	1.767	3.142	6.284	9.621	13.548	17.Ce1	* * * * * * * * *	N.	(FT/SEC)	84.33	98.63	111.25	123.07	133.56	137.43	138.59	139.89	***
	ETER: 3.00 AM/AP: 3. METER: 2.3 A: 0.70 SSURF: 29.	ZN4-		5.18	3.94	2.74	1.90	0.73	0.36	0.19	0.13	0.0	ď	(FT/SEC)	253.01	252.45	252.20	251.68	251.49	251.32	251.10	251.26	250.39
	UPTAKE DIAMETER: 3 AREA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIENT PRESSURF:	PA-PS	(INCHES OF WATER)	5.18	3.94	2.14	1.80	0.73	0.36	0.19	0.13	0.0	S.M.	(LBM/SEC)	0.0	0.053	660.0	0.143	0.182	0.196	0.201	0.205	*****
-025/10		PU-PA	ONI	6.40	7.70	8.70	09*6	10.50	10.80	11.00	11.10	11.20	d	(Leh/SEC)	0.265	0.266	0.266	0.266	0.266	0.266	0.267	0.266	0.267
4/1/7.57/-025/10		TAMB	ENHEIT)	73.0	13.0	73.0	73.0	73.0	73.0	73.0	73.0	13.0	55"** 1+M		0.0	0.1876	0.3518	0.5045	0.6423	0.6928	0.7084	0.7245	*******
F -0.25	£	TUPT	(DEGREES FAHRENHEIT)	152.0	151.0	152.0	151.0	152.0	152.0	151.0	152.0	148.0	p*/T*		0.4177	0.3186	9-2224	0.1465	0.0592	0.0294	0.0155	2.0102	0.0
4. STAND'S	S: 4 0.866 INCH 71 INCHES 3.00 ENCHES	TOR	(DEG	152.0	151.0	152.0	151.0	152.0	152.0	151.0	152.0	148.0	<u>*</u>	•	0.870R	0.8723	0.8708	0.8723	0.8708	0.8708	0.8723	0.E708	0.8766
TRANSITION	TY NOZZLES: CIAMETER: (IGTH: 22.7) METER: 3 D: 7.57	ороя	JF WATER!	10.0	10.0	0.01	10.3	10.0	10.0	10-0	10.0	10.0	*		3638	9775-0	0 1037	1277	9150	0.0256	0.0135	0.0089	0.0
FOUR NOZZLES. ELLIPTIC TRANSITIOM. STAND'FF -0.25	NUMBER OF PRIMARY NOZZLES: 4 PRIMARY NOZZLE CIAMETEN: 0.866 INCHES MIXING STACK LENGTH: 22.71 INCHES MIXING STACK DIAMETER: 3.00 ENGHES HIXING STACK L/D: 7.57	POR	(INCHES OF WATE	12.4	13.8	14.8	15.7	16.6	16.8	17.1	17.1	17.2	3	i.	•	0.1993	0575 0	0.6350	4694 0	0789-0	0.7524	7699	*****
FOUR NOZZLE	NUMBI PRIM MIXII MIXII	2	RUN	~	8	· m	• •	· vr	۸ «	۰ ۸		. o	7		,	- 6	u 1	η .	† u	n 4	۰ ۰	- 5	

0745	CTAC	22300 7	9 STATE CTACK DOCCOME DICTRIBUTIONS FOR RUN: 9	RIBUTION	S FOR RU	٠ : N								
SUIVIE	7	2014									•			•
	× //) ×	0-0	0.5	0.1	. 1.5	2.0	2.5	3.0	3.5	٠.0	4.5	2.0	n •	
			9000	-0.545	-0.215	-0.045	0-125	0.180	0.205	0.175	0.130	0.140	C.050	0.040
PAN ALIN. HZUI: -11-10	: 102	0111	10000						410		000	0.00	4000	0.003
PMS	. Y:	PMS* A: -0.105	-0.071	-0.039	-0.015	-0.003	0.003	0.013	610.0	610.0				
NA PAR DAG	1203	A 114 H2011 -1-370	076-0-	-0.625	-0.305	-0.060	0.100	0.165	0.185	0.165	6.125	0.130	0.050	0.035
VN0		860-0- :8 *540	-0.070 -0.045 -0.022	-0.045	-0.022	2 -0.004 0.007 0.012 0.013	0.007	0.012	0.013	0.012	600.0	0.009	0.004	0.003
)			J	U/5 (P	= -0.2	ນູ					

(d) S/U = -0.25Table XIV. Continued.

DATA TAKEN 11 AUG 77 BY PETE HARRELL

FOUR NOZZLES, ELLIPTIC TRANSITION, STANDOFF 0.25

4/1/5.57/025/10

PRIMA	PRIMARY NC22LE CIAM	C I AMETER:	ETER: 0.866 INCHES	ES		•	AREA RATIO, AM/AP:		3.00		
MIXIM	MIXING STACK LENGTH	ENGTH: 16.7	: 16.71 INCHES			J	URIFICE DIAMETER:		2.154 INCHES		
NIXIN	MIXING STACK DIAPET	ER:	3.00 INCHES		•	•	ORIFICE BETA: 0.70	A: 0.70			
MIXIN	HIXING STACK L/D:	5.5					AMBIENT PRESSURE:		29.72 INCHES HG	HG	
z	PCR	DPCR	108	TUPT	TANB	PU-PA	PA-PS	PA-PNZ	SECONDARY AREA	AREA	
RUN	IIACHES CF M	CF WATERS	1066	(DEGREES FAHRENHEIT)	ENHE (T)	CINC	(INCHES OF WATER)	ER)	(SQUARE INCHES)	CHES)	•
-	12.5	10.0	146.0	146.0	72.0	07-9	5.08	5.08	0.0		
~	12.7	10.0	146.0	146.0	72.0	7.70	3.84	3.84	0.785	2	
n	14.9	10.0	146.0	146.0	72.0	8.90	2.76	2.76	1.767	_	
4	16.0	10.C	146.0	146.0	72.0	9.90	1.78	1.78	3-142	2	
5	17.0	10.0	146.0	146.0	72.0	10.90	0.73	0.13	6.284	•	
9	17.2	10.0	146.0	146.0	12.0	11.20	0.36	0.36	9.621	-	
1	17.5	10.0	146.0	146.0	72.0	11.40	07.0	0.20	13.548	80	
89	17.5	10.0	146.0	146.0	72.0	11.50	0.13	0.13	17.081	_	•
٥	17.6	. 10.0	146.0	146.0	12.0	11.60	0.0	0.0	*****	•	
z	*	å	:	P*/1*	55"**I*M	ğ	¥	ПР	¥,	3	UPT MACH
KUN						(LBM/SEC)	(LBM/SEC)	(FT/SEC)	(FI/SEC)	(F1/SEC)	
-	0.0	0.3596	0.8778	9605.0	0.0	0.266	0.0	252.58	61.18	84.19	0.070
2	0.1561	0.2127	0.6778	0.3107	0.1852	0.266	0.052	252.16	98.38	84.05	0.070
ω	0.3737	0.1565	0.8778	0.2239	0.3529	0.266	0.100	251.85	111.29	83.94	0.070
4	0.5329	0.1270	0.8778	0.1447	0.5033	C-247	0.142	251.56	122.90	83.85	0.070
v	0.6755	0.0519	0.6778	0.0591	0.6416	0.267	0.181	251.20	133.58	85.13	0.069
9	0.7329	0.0258	0.8778	0.0294	0.6920	0.267	961.0	251.04	137.45	83.67	0.069
2	6.1593	0.010	0.6178	0.0159	0.7169	0.267	602.0	251.02	139-41	83.67	0.069
80	0.7816	0.0093	0.8778	0.0106	0.1380	C-261	0.209	250.98	141.03	83.66	0.069
0	******	0-0	0. 6778	0.0	*******	0.267	******	250.93	*****	83.64	0.069

0.055 0.004 0.000 0.003 0.000 0.005 0.075 (a) S/D = 0.250.001 0.025 0.015 0.002 0.010 0.020 0.001 100.0 -0.015 10000-MIXING STACK PRESSURE DISTRIBUTIONS FOR RUN: 9 -0.105 -0.055 -0.004 -0.025 -0.510 -0.022 -0.345 PMS+ 8: -0.073 -0.C48 -C.64C -0.046 -C.665 PHS* A: -0.075 PMS ALIN. H201: -1.050 PRS BIIN. 11201: -1.020 0.0 :0/x

Table XV. Four-Nozzle Performance Data for L/D = 5.57, $M_{\rm u} = 0.068$, Elliptic Transition.

DATA FAKEN 11 AUG 77 BY PETE FARRELL

	UPTAKE DIANETER: 3.00 INCHES AREA RATIO, AM/AP: 3.00 ORIFICE DIAMETER: 2.154 INCHES DRIFICE BETA: 0.70	AMBIENT PRESSURE: 29.72 INCHES HG
4/1/5.57/0/10		
FCUR NOZZLES, ELLIPTIC TRANSITION, STANDOFF 0.0	NUMBER OF PRIMARY NOZZLES: 4 PRIMARY ACZZLE CIANETER: 0.866 INCHES PIXING STACK LENCTH: 16.71 INCHES MIXING STACK DIAPETER: 3.00 INCHES	

												UPT MACE		0.010	0.070	0.070	0.069	690.0	0.069	0.069	0.069	0.069
AREA	(CHES)		35	15	2	75	=		=			ממ	(FI/SEC)	84.22	84.07	83.95	83.84	83.73	83.68	83.66	83.65	83.63
SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	17.081	******		3	(FI/SEC)	84.22	98.59	111.50	123.22	134.11	138.93	140.81	142.12	****
PA-PNZ	ER)	5.20	3.94	2.80	1.81	0.76	0.38	0.21	91.0	0.0		d D	(F1/SEC)	252.66	252.23	251.87	251.52	251.20	251.05	251.00	250,96	250.90
PA-PS	(INCHES OF WATER)	5.20	3.54	2.80	1.81	0.76	0.38	0.21	91.0	0.0		ĸS	(LBM/SEC)	0.0	0.053	0.100	0.143	0.186	0.201	0.208	0.213	*****
PU-PA	CINC	05.9	7.60	8.80	9.70	10.80	11.10	11.30	11.30	11.50		d.	(LBM/SEC)	0.266	0.266	0.266	0.267	0.267	0.267	0.267	0.267	0.267
TAMB	ENHE 1 T)	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0		44.**TaN		0.0	0.1876	0.3554	0.5076	0.6570	0.7110	0.7352	0.7522	*******
TUPT	(DEGREES FAHRENHEIT)	146.0	146.0	146.0	146.0	146.0	146.0	146.0	146.0	146.0	!	*1/*d		0.4190	0.3186	0.2271	0.1472	0.0620	0.0310	1910.0	0.010	0.0
108	1060	146.0	146.0	146.0	146.0	146.0	146.0	146.0	140.0	146.0	·	*		0.8778	0.8778	0. £178	0.8778	0.6778	0.6778	0.8778	0. £778	0.8778
CPCR	CF MATER!	10.0	10.C	10.0	10.0	10.c	10.0	10.0	10.0	10.0	į	*		C-3678	C-2757	6658.0	0.1292	0.0544	0. (272	0-0147	0.0057	0.0
FCR	CINCRES	12.5	13.1	14.5	15.8	16.9	17.2	17.4	17.4	17.5	;	¥		0.0	0.1986	0.2764	6.5375	1559.0	0.1529	0.7786	9961-0	*****
z	RUN	-	2	m	4	ď	9	~	89	S	;	z	RUN		7	m	4	w	•	~	0	٥

ISTRIBUTIONS FCR KUN: 9		0.075	5 0.001 0.001 0.005	0 -0.020 0.0	300 0 0 0 0 00 0 9
LRE DISTRIBUTIONS	0.5 1.0	-0.885 -0.500 -	-0.063 -0.036 -	-C.865 -0.525 -	-0-062 -0-038 -
MIXING STACK PRESSI	x/E: 0.0	FRS /(IN. +20): -1.310	PMS+ A: -0.094	PMS ELIN. H201: -1.240	PMS* B: -0.089

(b) S/D = 0.0 Table XV. Continued.

CATA TAKEN 11 AUG 17 BY PETE HARRELL

*
4/1/5-57/-025/10
-0.25
STANDOFF
ELLIPTIC TRANSITION,
ELLIPTIC
OUR NOZZLES, 6
OUR

												UP T MACH		0.010	0.010	0.000	690.0	0.069	690.0	0.069	690.0	690.0
НG	REA	HESI				<u> </u>			_			9	(FT/SEC)	84.22	84.07	83.94	83.83	83.70	83.65	83.62	83.63	83.61
UPTAKE DIAMETER: 3.00 INCHES AREA RATIU, AM/AP: 3.00 ORIFICE DIAMETER: 2.154 INCHES ORIFICE BETA: 0.7C AMBIENT PRESSURE: 29.72 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3-142	6.26	9-621	13.548	17.081	*****	\$	(F1/SEC)	84.22	98.64	111.54	123.54	134.74	139.95	141.46	143-17	**7***
ETER: 3.0 AM/AP: 3 HETER: 2. A: 0.7C SSURE: 29	PA-PNZ	ERI	5.22	3.57	2.81	1.84	92.0	0.40	0.21	0.14	0.0	à	(FT/SEC)	252.67	252.22	251.85	15.122	251.11	250.97	250.88	256.90	250.84
UPTAKE DIAMETER: 3.00 INCHES AREA RATIU, AM/AP: 3.00 ORIFICE DIAMETER: 2.154 38CH ORIFICE BETA: 0.70 AMBIENT PRESSURE: 29.72 INCH	PA-PS	LINCHES OF WATER!	5.22	3.97	2.81	1.84	92.0	05.0	0.21	0.14	0.0	N.S	(LBM/SEC)	0.0	0.053	C-100	0-144	0.186	0.205	0.210	0.217	******
5 4 6 5 4	PU-PA	(116C)	6.30	7.60	9.70	09-6	10.50	10.80	11.00	11.10	11.20	d 3	(LBM/SEC)	0.266	0.266	0.266	192.0	0.247	0.267	0.267	0.267	0.267
	TAMB	NHE IT)	72.0	72.0	72.0	72.0	72.0	72.0	72.0	12.0	72.0	74. 1 * * 44		0.0	0.1883	0.3561	0.5118	0.6572	0.7251	0.7445	0.7662	*******
S	TUPT	(DEGREES FAHRENHELT)	146.0	146.0	146.0	146.0	146.0	146.0	146-0	146.0	146.0	p*/1*		0.4206	c.3210	0.2219	0-1496	0.0620	0.0323	0.0172	0.0114	0.0
2LES: 4 ER: 0.866 INCHES 16.71 INCHES : 3.00 INCHES	101	(DEGI	146.0	146.0	146.0	146.0	146.0	146.0	146.0	146.0	146.0	÷		0.6778	0.6778	0.8778	0.6778	0.8778	0.8778	0.8778	0.6778	0. €178
Y NCZZLES:)IAMETER: (GTH: 16.7 HETER: 3.	DPCP	(INCLES OF WATER)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	0.01	10.0	å		0.3652	0.2618	0.2001	9151.0	0.0544	0.0283	0. C151	0010-0	0.0
NUPBER OF PRIMARY NCZZLES: PRIMARY NOZZLE DIAMETER: 0. MIXING STACK LENGTH; 16.71 PIXING STACK DIAMETER: 3.0 MIXING STACK L/D: 5.57	PCR	(INCHES (12.5	13.6	14.8	15.7	16.6	16.9	17.0	17.2	17.3	1		0-0	0.1554	0.3771	0.5421	0969*0	0.1679	0.7884	0.8114	******
NUPBI PRIM MIXIN PIXIN	z	RUN	-	7	m	4	S	9	7	3 0	6	z	RUN		7	æ	4	ĸ	•	2	20	6

PIXING STACK PRESSURE CISTRIBUTIONS FOR RUN: 9

	0.4	0.035	0.003	C.035	0.003		
	3.5	0.005	0.000	0.055	0.004	2	ned.
	3.0	-0.005	-0.000	-0.020	-0.0C1	= -0.2	Contin
	2.5	-0.050	-0.004	-0.070	-0.012 -0.005 -0.001 0.004	(c) $S/D = -0.25$	Table XV. Continued.
٠ ۲	2.0	-0.150	-0.011	-0.170	-0.012	ٽ	Tab
rck ku	X/0: 0.0 C.5 1.0 1.5 2.0	-0.340	-0.024	-0.405	PMS* B: -0.104 -0.076 -0.052 -0.029		
NOT TORT	1.0	-0.105	150.0-	-0.725	-0.052		
	6.5	-1.100	-0.079	-1.060	-0.076		
K PRESS	0.0	-1.560	-0.112	-1.450	-0-104		
FIXING STACK PRESSURE LISTRIBUTIONS FOR KON: 9	:0/x	PMS Alin. H201: -1.560 -1.100 -0.705 -0.340 -0.150 -0.050	PMS* A: -0.112 -0.079 -0.051 -0.024 -0.011 -0.004	PMS B(IN. F20): -1.450 -1.060 -0.725 -0.405 -0.170 -0.070 -0.020	PMS+ E:		
		A.		PA			

97	TO THE POST OF THE PARTY OF THE	OV 1.(771 64	4			ă	UPTAKE DIAMETER:		3.00 INCHES		
	NOMBER OF FRIENDS TELECTORY . G. BAG INCHES	CIAPETER: C	SAGE INCHE	Ş		Ą	AREA RAIIU, AM/AP: 3.00	AM/AP: 3.	00		
	-		13.71 INCHES	·		ð	URIFICE DIAMETER:		2.154 INCHES		
7	MIXING STACK CERCISO 15.		3.00 INCHES			Ò	URIFICE BEIA: 0.70	02.0			
XIX	FIXING STACK L/C:					₹	AMBIENT PRESSURE:		29.76 INCHES HG	911	
2	a)d	OPCR	. 401	TUPI	TAMB	PU-PA	Sd-V	PA-PNZ	SECONDARY AREA	KEA	
2 2	CINCHES OF N		(D=0)	(DEGREES FAHRENHEIT)	ENHE LT 3	CINCI	(INCHES OF WATER)		(SQUARE INCHES)	HE 5)	
-	12.6	10.0	145.0	145.0	12.0	9.50	5-15	5.15	0.0		
. ^	13.7	10.0	145.0	145.0	12.0	01-1	4-00	4.00	0.785		
ו ת	6-71	10.0	145.0	145.0	72.0	8.80	2.76	2.76	1.767		
, 4	15.9	10.0	145.0	145.0	12.0	9.80	1.79	1.79	3-145	A 1	
	16.9	10-0	145.0	145.0	72.0	10.90	0.74	0.74	6.284		
٠. ٠	17.3	10.01	145.0	145.0	72.0	11.30	0.37	0.37	9.621		
. ~	17.4	10.0	145.0	145.0	12.0	11.40	0.20	0.20	13.548	6	
. «	17.5	10.0	146.0	146.0	12.0	11.50	0.13	0.13	17.081	_	
6	17.6	10.0	146.0	146.0	12.0	11.60	0.0	0.0	******		
2	3	•	:	P*/1*	75 * * * 1 * 1.	ž	N.	ď	E S	3	UPT MACH
2 10	L		•			(TBW/SEC)	(LBM/SEC)	(FT/SEC)	(FI/SEC)	(F1/SEC)	
<u> </u>	0-0	0.3649	0.8793	0.4150	0.0	0.266	c-0	252.27	84.09	84.09	0.070
• ^	0.2000	C-2643	0.6793	0.5234	0.1890	0.266	0.053	251.88	15.86	83.55	0.070
, ((0.2734	0.1968	0.6793	0.2239	0.3529	0.261	C-100	251.46	111.15	83.82	0.010
٠ ،	0-5341	0-1280	0.6793	0.1455	0.5047	0.267	6.143	251.15	122.85	83.71	690.0
r v	0.4537	0-6521	0.6793	0.0599	0,6460	0.267	0.183	250.80	133.75	83.59	0.069
٠ ،	0.7423	0.0266	0.8793	0.0302	0.7014	0.267	0.199	550.69	138.04	83.56	690'0
) ~	0.1587	0-0140	C- E793	0.0159	0.1170	0.267	0.203	250.61	139.23	83.53	0.069
. 00	0.7664	0.000	0. e778	0.0102	0.7237	0.267	0.205	250.80	139.85	83.60	0.069
, ,	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	9	0.9778	0.0	*******	0.267	******	250.76	*****	83.58	690-0

-0.165 -0.090 -0.010 -0.012 -0.006 -0.001 0.0 -0.140 -0.120 -0.009 MIXING STACK PRESSURE CISTRIBUTIONS FOR RUN: 9 -0.010 -0.225 -0.250 -0.016 PMS #11N. 1-201: -1.040 -C.565 -0.680 -C.042 PMS B(1N. H201: -1.050 PHS* A: -0.075

-0.01B

P::S+ B: -0.075 -C.649

3.0 0.060 0.004

0.020

Four-Nozzle Performance Data for 1/0 = 4.57, $M_{u} = 0.068$, Elliptic Transition. Table XVI.

(a) S/D = 0.25

TARRELL	
7 6 3 6	
10	
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7	
JAKEN	
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•					x		•		-	•		-					UPT MACH		0.070	0.070	0.00	690.0	690.0	690.0	0.069	590.0	0.069
					НС	AREA	CHES)		10	~	~	•	_			•	3	(FT/SEC)	84.08	83.98	83.82	83.71	83.60	83.55	83.52	83.52	15.58
	O INCHES	2.00	2-154 INCHES		29.16 INCHES HG	SECUNDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3-145	6.284	9.621	13.548	17.081	***	5	(F1/SEC)	84.08	98.11	111.39	123.28	134.77	138.77	140.63	140.86	****
				A: 0.70		PA-PN2	ERJ	5.20	4.10	18.2	1.83	0.17	0.38	0.21	0.13	0.0	ď	(FT/SEC)	252.24	251.94	251.46	251-15	250.82	250.67	250.59	250.57	250.13
	PIAKE DIAM	AKEA KAIIU, AM/AF:	ORIFICE DIAMETER:	ORIFICE BETA: 0.70	AMBIENT PRESSURE:	PA-PS	, (INCHES OF WATER)	5.20	4.10	18-2	1.83	0.77	96.0	0.21	61.0	0.0	#S	(LBM/SEC) (LBM/SEC)	0.0	0.054	0.100	0.144	0.186	0.201	0.208	0.209	•••••
01/0	5 3	₹	ō	3	₹	PU-PA	, (INC	05-9	1.60	8.80	9.70	10.80	11.20	11.30	11.40	05-11	ď	(LBM/SEC)	0.266	0.266	0.267	0.267	0.267	192-0	0.267	0.267	0.267
01/0/15-5/1/5						TAMB	NHE ET)	72.0	72.0	72.0	72.0	72.0	72.0	12.0	12.0	72.0	75. **I*W		0.0	0.1913	0.3561	0.5104	0.6591	0.7109	0.7352	0.7381	*******
0.0	į	ES				rupr	· (DEGREES FAIRENHEET)	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	146.0	P+/1*		0.4192	0.3313	0.2279	0.1488	0.0624	0.0310	0.0167	0.0106	0.0
I, STANDUFF	4	1.866 INCHI	13.71 INCHES	3.00 INCHES		10R	· (0EG	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	146.0	:		0.8793	0.8793	0. £793	0.8793	0.8753	0.8192	0.8793	0.8793	0. 6778
TRANS IT IUN	Y NCZZLES	IAPETER: (GT+1 13.7		23	OPCA	F HATER!	10.0	10.0	1C.C	10.0	10.C	10.0	10.0	10.0	10.0	č	•	0.3686	0.2913	C. 2004	0.1208	0.0548	0.0273	0.0147	0.0053	0.0
FCUR NOZZLES, ELLIPTIC TRANSITION, STANDUFF 0.0	NUPBER JF PRIMARY NCZZLES:	PRIMARY NUZZLE CIARETER: 0.866 INCHES	PIXING STACK LEAGIFT	MIXING STACK DIAMETER:	PIXING STACK L/D: 4.	PCR	INCLES OF HATE	12.4	13.7	14.8	15.8	16.9	17.2	17.3	17.4	17.5	:	ŧ	0.0	0.2025	0.3768	10.5401	0.6975	0.7523	0.7780	0.7811	***
FEUR NOZZLE	というと	PRIT	F1X1	IXIW	ı XIX	z	S S S S S S S S S S S S S S S S S S S	-	~	เก	4	· w	. •	7	80	٥	2	: 3	-	. 2	'n	7	, vo	· •0	. ~	· 00	6

-0.280 -0.170 -0.035 -0.020 -0.012 -0.003 -0.029 -0.001 -0.260 -0.160 110.0- 610.0-PIXING STACK PRESSURE CISTRIBUTIONS FOR RUN: 9 -0.027 -0.350 -0.380 -0.025 1.0 PMS ALIN. F201: -1.330 -0.845 PHS E(IN. F20): -1.260 -0.880 PMS+ 8: -C.090 -C.C63 FMS+ A: -0.095 -0.061 0.0 :0/x

0.055 0.004 0.025 (b) S/D = 0.0

Table XVI. Continued.

DATA TAKEN 12 AUG 77 BY FEIE HARRELL

4/1/4.57/-025/10 FOUR NOZZLES, ELLIPTIC TRANSITION, STANDUFF -0.25

										TOTAL LOSS	Hawki	07070	0.070	0.070	590-0	0.069	690.0	690.0	0.069	0.069
S S	AREA	NCHE S1	85	۲5	۲,	5	= 0	.	. +	3	(FT/SEC)	84.36	84.24	84.08	83.58	B 3 • 86	83.81	83.78	83.77	83.54
3.00 INCHES 3.00 2.154 INCHES 2.9.76 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.185	1.767	5.142	6.284	9.621	10.048	*********	¥	(F1/SEC)	84.36	99.00	111.66	123.88	135.36	139.39	140.89	142.20	*****
·	PA-PNZ	A 1EK) 5.25	4.08	2.81	1.86	2 0	0.27	77.0	0.0	å) (FT/SEC)	253.11	252.73	252.26	251.97	251.59	251.44	251.35	251.31	550.64
UPTAKE DIAMETER: AREA RATIO, AM/AP: URIFICE DIAMETER: ORIFICE BETA: 0.7 AMBIENT PRESSURE:	PA-PS	5-25 5	4.08	2.81	98.1	96.0	0.21	0-14	0.0	H	(LBM/SEC)	0.0	0.054	C-100	0.145	0.188	0.202	0.208	0.213	*****
	PU-PA	6.30	1.60	8.60	09.6	06-01	11.10	11.10	11.20	d X	(LBM/SEC)	0.265	0.265	0.266	0°566	0.266	0.266	992.0	0-266	0.267
	TAMB	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	76.44.14K		0.0	0.1910	0.3563	0.5148	0.6638	0.7160	0.7357	0.7527	*****
HES S	TUPT TAMB	149.0	149.0	149.0	149.0	149.0	149.0	149.0	146.0	P*/1*		0.4231	0.3298	0.2280	0.1513	7690-0	*150.0	1910.0	0.110.0	D. D
22LES:	10R (0E	145.0	149.0	145.0	149.0	149.0	149.0	148.0	146.0	*	,	0.8735	0.8735	0.8732	26132	0.0132	0.6746	0.0135	0.6330	8/ 23 -0
ARY NC22LES: Clameter: 0. Ength; 13.71 Iapetep: 3.c	EPCR CF WATER)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10°C	đ.	70%	0.1070	1007.0	1661.0	0.6662	0.0275	0-6146	0-6006	0-0	3
NUPBER OF PRIMARY ACZZLES: 4 PRIMARY NOZZLE CIAMETER: 0.866 INCHES MIXING SIACK LEAGTF: 13.71 INCHES PIXING SIACK DIAPETEP: 3.00 INCHES MIXING STACK L/D: 4.57	PCR EPEN	12.4	13.6	15.7	16.7	17.0	17.1	17.1	17.2	*	0	0.000	6.3781	0.5463	0.7045	007.0	0.7805	0.7989	******	
8 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	א ת גר א	-	~ ~	ı 😍	'n	9	_	6 0	3	z i	.	. ~	. "			.~	_	-	•	

MIXING STACK PRESSLRE DISTRIBUTIONS FCR RUN: 9 X/0: 0.0

PMS* B: -0.104 - C.C77 -0.036 -0.029 -0.011 -0.006 0.0 (C) S/D = -0.250.025 0.002 3.0 0.0 -0.028 -0.019 -0.0us -0.410 -0.235 -0.080 -0.065 -0.480 -0.395 -0.260 -0.500 -0.034 PMS ALIN. H201: -1.530 -1.640 PMS B(IN. H2G): -1.450 -1.670 -6.075 PMS* A: -0.110

Table XVI. Continued.

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CATA TAKEN 19 AUG 77 BY PETE HARRELL

4/1/3/025/10
0.25
STANDUFF
TRANSITION,
ELL IPTIC
NOZZLES, E
FOUR

												UPT MACH		0.070	0.070	690.0	690.0	690-0	690.0	690.0	690.0	690.0
нG	AREA	CHES)		Š	7	2	ş	-	80	=	*	3	(F1/SEC)	84.58	84.41	84.34	84.23	84.12	84.07	84.05	84.05	83.97
3.00 INCHES 3.00 2.154 INCHES 00 29.83 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0-0	0.785	1.767	3-142	6-284	9.621	13.548	17.081	******	¥ 5	(FT/SEC)	84.58	11.66	111.91	123.43	134.53	138.28	139.84	141.49	***
UPTAKE DIAMETER: 3.00 I AREA RATIO, AM/AP: 3.00 ORIFICE DIAMETER: 2.154 ORIFICE BETA: 0.70 AMBIENT PRESSURE: 29.83	PA-PN2	ER.)	5.10	4.00	2.80	1.79	0.14	0.37	0.20	0.13	0.0	å	(FI/SEC)	253.76	253.43	253.04	252.71	252-38	252.24	252.16	252.18	251.92
UPTAKE DIAMETER: 3 ANEA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	5-10	4.00	2.80	1.79	0.74	0.37	0.20	0.13	0.0	ĸ	(LBH/SEC) (FT/SEC)	0.0	0.053	C- 100	0.142	0.183	0.197	0.203	0.209	******
5 4 5 5 4	PU-PA	CINC	9-40	7.60	8.80	05.6	10.90	11.20	11.40	11.50	11.60	, š	(LBM/SEC)	0.264	0.265	0.265	0.265	0.266	0.266	0.206	0.266	0.266
,	TAHB	NHE 1 T)	75.0	15.0	75.0	15.0	15.0	75.0	15.0	15.0	15.0	77°**J*M		0.0	0.1891	0.3556	0.5050	0.6485	1769.0	0.7174	0.7383	******
ES	TUPI	(DECREES FAHRENHEIT)	154.0	154.0	154.0	154.0	154.0	154.0	154.0	154.0	153.0	P*/1*		0.4113	0.3234	0.2271	0.1456	C. 0603	0.0298	0.0159	0.0106	0.0
2LES: 4 ER: 0.866 INCHES 9.00 INCHES : 3.00 INCHES	108	CDEC	154.0	154.0	154.0	154.0	154.0	154.0	154.0	154.0	153.0	÷		0.8713	6113.0	0.6713	0.6713	0.6713	0.8713	0.8713	0.8713	0.8727
RY ACZZLES CIAMETER: NGTH: 9.0 APETER: 3	DPCA	(INCHES OF NATER)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.	10.0	å		0.3583	0. 26 18	C. 1579	0.1268	0.0526	0.0260	0.0139	0.0092	0.0
MUMBER OF PRIMARY NCZZLES: 4 PRIMARY NCZZLE CIAMETER: 0.866 INCH PIXING STACK LENGTH; 9.00 INCHES PIXING STACK DIAMETER: 3.00 INCHES MIXING STACK L/C: 2.00	PCR	LINCHES	12.5	12.7	14.9	15.9	17.0	17.3	17.4	17.6	17.7	*		0 •0	6002-0	0.2778	0.5366	0.6891	C. 7407	0.1623	C. 1645	*****
N TENE	z	NO.	-	8	m	4	'n	9	2	89	6	z	RUN	-	2	m	4	'n	9	~	œ	¢

MIXING STACK PRESSURE CISTRIBUTIONS FOR RUN: 9

-0.015 -0.040 -0.003 -0.001 1.83 -0.145 -0.010 -0.170 -0.012 -0.345 -0.030 -0.025 -0.420 -0.036 -0.037 -0.525 -0.500 -1.070 -1.010 -0.076 PMS* 8: -0.032 -C.C72 0.0 x/0: -0.67 PMS B(IN. H20): -0.450 PMS* A: -0.031 PMS #11N. #201: -0.430

(a) S/D = 0.25

Table XVII. Four-Nozzle Performance Data for L/D = 3, M_u = 0.068, Elliptic Transition.

EATA TAKEN 19 AUG 77 BY PETE HARRELL

FLUR NUZZLES, ELLIPTIC TRANSITION, STANDOFF 0.0

4/1/3/0/10

PRIMA	PRIMARY NCZZLE CIAME Hiving Steek (Engle)		ELER: O.BGG INCHES	Ų							
MIXIM	A NOTE OF		1111	3		₹	AREA RAIIU, AH/AP:		3-00		
	מ שוני בי		9.00 INCHES			Ö	ORIFICE DIAMETER:		2.154 INCHES		
MIXIN	HIXING STACK DIAMET		FR: 3.00 INCHES			Ö	ORIFICE BETA: 0.70	A: 0.70			
FIXIN	PIXING STACK L/C:	00*€ :3/				₹	AMBIENT PRESSURE:		29.83 INCHES HG) HC	
z	PLR	DPCA	108	1 00 1	TAMB	PU-PA	PA-PS	PA-PNZ	SECONDARY AREA	AREA	
RUN	(INCHES OF W	CF MATER)	1066	(DEGREES FAHRENHELT)	ENHELT)	C I NC	(INCHES OF WATER)	ERI	(SQUARE INCHES)	CHES	
-	12.3	10.0	154.0	154.0	15.0	6.20	5.15	5.15	0.0		
2	13.5	10.0	154-0	154.0	75.0	7.40	6. 00	4.00	0.785	5	
m	14-7	10.0	154.0	154.0	15.0	8.60	2.15	2.15	1.767		
4	15.7	10.0	154.0	154.0	75.0	09.6	1.78	1.78	3.142	2	
S	16.7	16.0	154.0	154.0	15.0	10.60	0.73	0.73	6.284	4	
9	17.0	10.0	154.0	154.0	75.0	11.00	0.36	0.36	9.621	**	
1	1.7.1	10.0	154.0	154.0	15.0	11.10	61.0	0.19	13.548	8	
89	11.2	10.0	154.0	154.0	15.0	11.10	0.12	0.12	17.081	-	
6	17.5	10.0	153.0	153.0	75.0	11.50	0.0	0.0	****	*	
z	*	å	*	P*/1*	55°**1#A	3	N.S	пр	5	n	UPT MACH
KUN					•	(18H/SEC)	(LBM/SEC)	(F1/SEC)	(F1/SEC)	(FT/SEC)	
_	0.0	0.3619	0.6713	0.4154	0.0	0.264	0.0	253.74	84.57	84.57	0.010
2	0.2010	0.2819	0.8713	0.3236	0.1891	0.265	0.053	253.37	60*66	84.45	0.070
'n	0.3145	0.1545	0.6713	0.2232	0.3525	0.265	0.099	252.95	111.64	84.31	690.0
4	0.5352	0.1262	0.8713	0.1448	0.5037	0.265	0-142	552.64	123.30	84.21	0.069
S	0.6823	0.(515	0.6713	0.0592	0.6422	0.266	0.181	252.26	133.99	84.09	0.069
•	C-1358	0.0256	6.8713	0.0294	0.6925	0.266	961-0	252-14	157.88	84.04	690.0
7	C.1527	0.0135	0.8713	0.0155	0.1084	0.266	0-200	252.07	139.09	84.02	690.0
89	0.3541	6.0085	0.8113	0.0058	0.7097	0.266	C-200	252.05	139.19	10.78	0.069

-0.040 -0.050 -0.004 -0.240 -0.250 -0.018 -0.017 RIXING STACK PRESSURE CISTRIBUTIONS FOR RUN: 9 -0.500 -0.036 140-0- 940-0--0.575 -0.625 059-0--0.045 -1.260 060-3--1.200 -0.086 PPS ALIN. F2C1: -C.550 PMS+ 4: -0.039 PMS B(1N. #201: -0.580 PMS* 8: -0.041

Table XVII. Continued.

(b) S/D = 0.0

206

es V

CATA TAKEN 19 AUG 17 BY FETE HARRELL

4/1/3/-025/10
-0-25
STANDUFF
IRANSITIUN,
ELLIPTIC
NOZZLES.
FUUR

UPT MACH 0.070 0.070 0.069	HG HES) HES) UU (FT/SEC) 84.62 84.35	UPTAKE DIAMETER: 3.00 INCHES AREA RATIO, AM/AP: 3.00 ORIFICE DIAMETER: 2.154 INCHES ORIFICE BETA: 0.70 AMBIENT PRESSURE: 29.85 INCHES HG PA-PS PA-PN SECONDARY AREA CHES CF MATER) (SQUARE INCHES) 5.30 5.30 0.0 4.04 4.05 0.0 1.79 1.79 1.767 1.79 1.79 5.405 0.73 0.73 6.284 0.12 0.19 13.548 0.12 0.12 17.081 0.0 0.0 ******************************	EFER: 3.0 AH/AP: 3 HETER: 2. A: 0.70 SSURE: 2. PA-PNZ ER) 6.30 4.05 2.80 1.79 0.73 0.36 0.12 0.0 UP (FT/SEC) 253.46 253.43	UPTAKE DIAMETER: 3.4 AREA RATIO, AM/AP: ORIFICE DIAMETER: 2. ORIFICE BETA: 0.70 AMBIENT PRESSURE: 2. LINCHES CF MAIER) 6.30 5.30 7.60 4.04 4.04 4.05 9.60 1.79 10.60 0.73 10.90 0.73 10.90 0.73 11.20 0.12 0.12 11.30 0.00 WA WA UP CLEM/SEC) (FI/SEC) C.26 0.26 0.26 C.26 C.26	3 3 3 3 3 3 3 3 3 3	10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	00000 77 1000	FUPT TAMB 15.0 154.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0 75	FUPT TAMB 15.0 154.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0 75	R: 0.86¢ INCHES 9.00 INCHES 9.00 INCHES 00 IOR	5: 4 0.86¢ INCHES 3.00 INCHES 3.00 INCHES 10k
0.069	84.10	125.42	252.68	0.181	0.265	0.5050	0.1456	0.6713	0.1269	0.5366	
690.0	84.22	123.42	252.68	0.142	0.265	0.5050	0.1456	6.6713	0.1269	0.5366	1 4
690.0	84.35	111.93	253.07	C-100	0.265	0.3556	0.2270	0.8713	C-1978	0.3778	æ
690.0	84.35	111.93	253.07	C-100	0.265	0.3556	0.2270	6179	0.2540	6107.5	2 (
0.070	84.41	99-19	253.43	0.053	0.265	1061-0	0.3267	0.8713	0.2646	6.2019	
0.070	84.62	84.62	253.86	0 • 0	6-264	0.0	0.4271	0.8713	0.3721	0.0	: -
	(F1/SEC)	(F1/SEC)	(FT/SEC)	(LBM/SEC)	(LBM/SEC)						N D
UPT MACH	20	NO.	a n	SH	¥	55***1*M	P+/1+	<u>.</u>	* d	* 3	7
	_	****	0.0	0.0	11.30	15.0	154.0	154.0	10.0	17.4	6
	_	17.081	0.12	0.12	11.20	15.0	154.0	154.0	0:01	17.3.	. 20
		13.54	0.19	0.19	11.00	15.0	154.0	154.0	10.0	17.2	7
	_	6.62	0-36	96.0	10.90	15.0	154.0	154.0	10.0	11.0	9
		6.284	0.73	0.73	10.60	15.0	154.0	154.0	10.0	16.8	uì
	•	3-14	1.79	1.79	09*6	15.0	154.0	154.0	10.0	15.8	æ
		1.76	2.80	2.80	8.80	75.0	154.0	154.0	10.0	15.0	m
	۰.۵	0.785	4.04	4.04	1.60	15.0	154.0	154.0	10.0	13.6	2
		0.0	5-30	5.30	06.30	15.0	154.0	154.0	16.0	12.4	
	HES	(SQUARE INC	ERJ	IES OF WAT	SW3	ENHEIT	REES FAHRE	OEG	CF NATERS	(INChES	Š
	IREA	SECONDARY A	PA-PNZ	PA-PS	PU-PA	TAMB	TUPI	10%	DPCR	FCR	2
	HG	0.83 INCHES		HBIENT PRE	Ā				D: 3.00	G STACK L/	HIXIN
	•	1	A: 0.70	RIFICE BET	ð			.00 INCHES		G STACK DI	FIXIN
		154 INCHES	MEIEK: 2.	RIFICE DIA	5			1 INCHES		G STACK LE	XIXIX
		3	A1/ A1.	CEA KAILU,	₹ :		S	3.866 INCH	DIAMETER: (RY NOZZLE	PRIMA
					;			+	HY ALZZEES	R OF PRIMA	NUFBE
		O INCHES		TAKE DIAM	ັລ			4	24 1/ 1 JV AD	A 1 1 0 0 2 0	9

PIXING STACK PRESSURE DISTRIBUTIONS FOR RUN: 9

X/D: -0.67 0.0 0.33 0.83 1.33 1.83

PHS A(IN. H20): -0.655 -1.410 -0.755 -0.640 -0.550 -0.050

PHS A(IN. H20): -0.047 -0.100 -0.054 -0.046 -0.024 -0.004

(c) S/D = -0.25Table XVII. Continued.

-0.070

-0.380

-0.690

-0.720

PMS* 8: -0.049 -0.095

PRS ELIN. H20): -C.690 -1.330

-0.049 -0.027

CATA TAKEN 15 AUG 77 BY PETE FARRELL

FOUR NUZZLES, CCNICAL IRANSITION, STANDOFF 0.25

												UPT MACH		0.070	0.070	0.010	0.070	0.010	690*0	690.0	0.069	690.0
H	AREA	снеѕя		S	2	2	4		30		•	20	(F1/SEC)	84.86	84.11	84.63	84.52	84-41	84.37	84.33	84.33	84.11
3.00 INCHES : 3.00 2.154 INCHES 70 29.03 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	17.081	****	¥	(FI/SEC)	84.86	99.32	112.22	124-22	135.21	139.12	140.37	140.83	* * * * * * * * * * * * * * * * * * * *
ETER: 3.0 AM/AP: 3 METER: 2. A: 0.70 SSURE: 25	P.A-PNZ	ER.)	4-84	3.52	2.78	1.82	0.75	0.37	0.20	61.0	0.0	ď	(FI/SEC)	254.59	254.31	253.89	253.59	253.24	253.12	253.01	253.00	252.33
UPTAKE DIAMETER: 3 AREA RATIO, AM/AP: DRIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	4.84	3.92	2.78	1.82	0.75	0.37	0.20	0.13	0.0	M.S	(LBM/SEC) (LBM/SEC)	0.0	0.052	669.0	0.143	0.183	151-0	0.202	0.204	****
3 4 5 5 4	PU-PA	CINC	01.9	7.70	8.80	9.80	10.80	11.10	11.30	11.30	11.50	å	(LBM/SEC)	0.263	0.264	0.264	0.264	0.265	0.265	0.265	0.265	0.266
	TAMB	ENHELT?	16.0	76.0	76.0	16.0	16.0	16.0	16.0	76.0	16.0	55"**1*M		0.0	0.1871	0.3543	0.5091	0.6506	0.7017	0.7173	0.7240	****
S	TUPT	(DEGREES FAMRENHEIT)	154.0	154.0	154.0	154.0	154.0	154.0	154.0	154.0	151.0	*1/*d		0.3904	0.5169	0.2255	0.1480	0.0607	0.6302	0. CI 59	0.0102	0.0
2LES: 4 ER: 0.866 INCHES 12.00 INCHES : 3.00 INCHES	10R	990)	154.0	154.0	154.0	154.0	154.0	154.0	154.0	154.0	151.0	*		0.8729	0.6729	0.8729	0.6729	0.8729	0.8129	0.8729	0.8729	0.6772
RY NCZZLES: CIAMETER: 0. NGTA: 12.00 APETER: 3.0	OPCR	LINCHES OF WATERS	1C.C	10.0	10.0	10.0	10.0	10.C	10.0	10.0	1Ç.C	\$		0.3408	0.2766	6.1568	0.1292	0.630	0.0264	0.0139	0.0089	o•c
NLPBER OF PRIPARY NCZ. PRIMARY NOZZLE CIAMETI HIXING STACK LENGTE: PIXING STACK DIAPETER MIXING STACK L/G: 4	PCH	LINCHES	12.8	13.8	14.8	15.8	16.9	17.3	17.3	17.4	17.5	*		0.0	0.1567	0.3761	0.5405	1069.0	0-1449	0.7615	0.7686	*****
PRID FIXI FIXI	z	RLN		2	ю	4	δ,	9	2	89	Ġ.	z	RUN		8	m	4	s	9	2	8	•

			Table XVII		
5.5	0.030	0.002	0.0	0.0	
2.0	-0.045	-0-003		900.0-	
1.5	-0-205	-r.015	-0.225	-0.016	
1.0	-0.400	-0.029	-0.450	-0.032	
6.5	-6.485	-0.035	-0.475	PMS* E: -0.081 -C.C34 -0.032 -0.016 -0.006	
x/C: 0.0	-1.250	-0.090	-1.130	-0.081	
x/C:	PHS ALIN. H201: -1.250 -C.485 -0.400 -0.205	PMS* A: -0.090 -0.035 -0.029 -f.015 -0.003	PMS E(1N. H2U): -1.130 -C.475 -0.450 -0.225	PMS+ B:	
	PHS		PMS		

(a) S/D = 0.25

II. Four-Nozzle Performance Data for L/D = 2,

 $M_u = 0.068$, Conical Transition.

FOUR NUZZLES, CONICAL TRANSITION, STANDOFF 0.0

					•							UU UPT MACH	(FT/SEC)	84.89 0.070	04.17 0.070	84.63 0.070	84.52 0.070	84.40 0.070	84.36 0.069	84.32 . 0.069	84.31 0.069	84.24 0.069
3.00 INCHES 3.00 2.154 INCHES 00 29.63 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	17.081	****	D WO	(FT/SEC)	84.89 84	99.48 84	112.42 84	124.32 84	135.37 84	139, 17 84	141.07 84	140.87 84	*****
ETER: 3.4 AH/AP: METER: 2 A: 0.70 SSURE: 2	PA-PNZ	ER)	5. CB	4.00	2.82	1.83	0.75	0.37	0.20	0.13	0.0	ПР	(LBM/SEC) (FT/SEC)	524.69	254.33	253.92	253.56	253.21	253.09	555.99	252.94	252.75
UPTAKE DIAMETER: 3 AREA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	5.08	4.00	2.82	1.83	0.15	0.37	0.20	0.13	0.0	MS		0.0	0.053	0.100	0.143	0.184	161.0	0-204	0.204	*****
` .	₽U-PA	WI J	6.50	1.60	8.70	09.6	10.70	11.00	11.10	11.10	11.40	ž	(LBM/SEC)	0.263	0.264	0.264	0.264	0.265	0.265	0.265	0.265	0.265
	TAMB	NHEIT	76.0	76.0	76.0	16.0	76.0	16.0	16.0	76.0	76.0	55" * * 1 * M		0.0	0.1891	0.3568	0.5106	0.6529	0.7018	0.7265	0.7242	******
S	TUPT	(DEGREES FARRENHEIT)	154.0	154.0	154.0	154.0	154.0	154.0	154.0	154.0	153.0	p*/T*		0.4094	0.3233	0.2287	0.1488	0.0612	0.0302	0.0163	0.0102	0.0
LLES: 4 ER: 0.866 INCHES 12.00 INCHES : 3.00 INCHES	10R	OFC	154.0	154.0	154.0	154.0	154.0	154.0	154.0	154.0	153.0	*		0.8729	0.8729	0.8729	0.8729	0. 6729	0.8729	0.8729	0,8729	0.8743
TY NCZZLES: CIAPETER: 0. VGTH; 12.00 NPETER: 3.4	DPCR	CF HATERS	10°C	1C.C	0.01	10.0	10.0	10.0	10.0	16.0	10.0	*d		0.3574	0.2822	0.1596	0.1299	0.0534	0.0264	. 6410-0	0.0089	0.0
NUMBER OF PRIMARY NCZZ PRIMARY NGZZLE CIAPETE MIXING STACK LENGTH; I MIXING STACK DIAPETER; MIXING STACK LC 4.	POR	(INCHES OF NATI	12.6	13.7	14.8	15.7	16.8	17.2	17.2	. 2.71	17.5	*		0.0	0.2007	C.3788	0.5421	1659.0	0.7450	6.7713	0. 1688	******
NUMBER PRIMAI MIXING MIXING	z	NO		2	m	4	s,	9	1	80	٠,	z	RUN		2	9	4	s	9	2	89	•

(b) S/D = 0.0
Table XVIII. Continued.

DATA TAKEN 15 AUG 77 BY PETE HARRELL

					HG	AREA	CHES)		ĸ	1	~			80	-	•	3	(FT/SEC)	84.88	84.78	84.63	84.50	84.37	84.32	84.30	84.30	84.28
	3.00 INCHES	3.00	2-154 INCHES		29.63 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3,142	6.284	9.621	13.548	196,55	****	5	(FT/SEC)	84.88	99.63	112.42	124.09	135.00	138-76	140-34	140.86	****
				TA: 0.70		PA-PN2	rer)	5.15	4 · C8	2.82	1.61	0.14	0.37	0.20	0.13	0.0	an O) (FT/SEC)	254.67	254.35	253.92	253.52	253-12	252.57	252.92	16.252	252.86
	UPTAKE DIAMETER:	AREA RATIO, AM/AP:	ORIFICE DIAMETER:	URIFICE BETA: 0.70	AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	5.15	4.08	2-82	1.81	0.74	16.0	0-20	0.13	0.0	N.	(LBM/SEC)	0.0	0.053	C-100	0.143	0.182	0.196	0.202	0.204	*****
5/10	2	•	•	3	•	PU-PA	CINC	06.30	7.50	8.60	9.50	10.40	10.70	10.90	11.00	11.10	ď	(LBM/SEC)	0.263	0.264	0.264	0.264	0.265	0.265	0.265	9.265	0.265
4/2/4/-025/10						TAMB	INHE LT)	16.0	16.0	16.0	16.0	76.0	76.0	0.97	76.0	16.0	77.**T*W		0.0	0.1910	0.3568	0.5019	0.6488	0.6973	921120	0.7242	******
-0.25		5:				TUPT	(DEGREES FAHRENHEIT)	154.0	154.0	154.0	154.0	154.0	154.0	154.0	154.0	154.0	p*/1*		0.4151	0.3297	0.2287	0.1472	0.0604	0.0298	0.0159	0.0102	0.0
, STANDOFF	4	OZZLE DIAMETER: C.866 INCHES	O INCHES	.00 INCHES		108	(DEG)	154.0	154.0	154.0	154.0	154.0	154.0	154.0	154.0	154.0	*		0.6729	0.8729	0.8729	0.8729	0.8729	0.8129	0.8729	0.8729	0.6729
IRANSITIGN,	PRIMARY NCZZLES:	STAMETER:	NGTF; 12.00	AMETER: 3.	00*+ :3	DPCR	GF WATER)	1C.C	10.0	1C-C	10.0	10.0	10.0	10.0	10.C	10.0	•		0.3624	0.2878	9661-0	0.1265	0.0527	0.020	0.0139	6800.0	0°C
FUUR NOZZLES, CCNICAL TRANSITIGN, STANDOFF	NUMBER OF PRIMA	PRIMARY NOZZLE	MIXING STACK LEAGTH; 12.00 INCHES	MIXING STACK DIAMETER: 3.00 INCHES	HIXING SIACK L/C:	PCR	IINCHES	12.4	13.6	14.8	15.6	16.5	16.8	17.0	1.7.1	17.2	ž		0.0	0.2027	0.3788	0.5392	0.6887	60-1403	0.7618	0.7689	******
FOUR NOZZLE	NUMB	PRIM	KIXI	TXI#	HIXI	z	RUN		8	'n	4	S	9	~	9	6	z	RUN	7	7	M	4	'n	9	1	80	6

UPT MACH

0.070 0.000 0.010 690.0 690.0 690.0 0.069

210

Table XVIII. Continued. (c) S/D = -0.25

2.5 -0.015

-0.490 -0.160 -0.035 -0.011

-0-054 -0.760 1.0

PMS+ 4: -0.116 -0.056

-C-780

PMS A(IN. H20): -1.620

MIXING STACK PRESSURE DISTRIBUTIONS FOR RUH: 9

-0.001

-0.820 -0.535 -0.240 -0.059 -0.038 -0.017

PMS B(IN. H20): -1.520 -0.710 PMS* 8: -0.108 -0.651

				ES)	ES MG		Y AREA	INCHES)	0	0.785	1-767	3-142	786	107.0			*		3	(FT/SEC)	84.19	84.72	84.57	84.45	84.35	84.30	84.28	84.26	83.10
		3.00 INCHES	3.00	2-154 INCHES		29.72 INCHES HG		SECONDARY AREA	(SQUARE INCHES)	0.0	0	: -		4		13.568	180-71	******		5	(FI/SEC)	64.79	99.31	111.99	123.73	134.86	138.61	140-17	140-69	***
			AREA RATIO, AM/AP:	ORIFICE DIAMETER:	9	e:		744-44	ATERI	4.80	3.56	2.76	1.79	0.74	0.37	0-20	0-13	0.0	!		:) (F1/SEC)	254.40	254.17	253.71	253.31	253.07	252.93	252.85	252.81	251.11
* .	!	UPTAKE DIAHETER:	AREA RATI	ORIFICE	ORIFICE BETA:	AMBIENT P	5 G T V 3	2	(INCHES OF WATER)	4.80	3.96	2.76	1.79	0.74	16-0	0.20	0:13	0.0) (LBM/SEC)	0.0	0.053	0.099	0.142	Ó-183	0.196	0.202	0.204	*****
01/570/							PII-DA		3	6.80	7.80	8.80	9.80	10.50	11.10	11.30	11.40	11.50	•	È.	(L.BM / SEC.)	992-0	0.264	0.264	0.265	0.265	0.265	0.265	0.265	0.267
4/2/3.0/025/10							TAMB		ENIE 11	75.0	15.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	***************************************			0.0	0.1881	0.3531	0.5051	0.6485	0.6971	0.7174	0-7242	*****
F 0.25			HES		S		TUPT		LUCUREES FAMENMETTS	155.0	155.0	155.0	155.0	155.0	155.0	155.0	155.0	147.0	D# / I.*		,	0. 3872	0.3200	0.2239	0.1456	. 0.0603	0.0298	0.0159	0.0102	0.0
N. STANDUF	7 . 5	•	0-866 INC	00 INCHES	3.00 INCHES		TCR	201	יייי	155.0	155.0	155.0	155.0	155.0	155.0	155.0	155.0	147.0	*		,	8698 0	0.8698	C. 8698	C. 6698	0.8698	0.8698	0.8698	8598.0	0.8813
TRANSIFIC	F PRIMARY NO. 21 FS :	777700	NCZZEE LIAPETER: 0.866 INCHES	FIXING STACK LENGTH; 9.00 INCHES	 	/C: 3•00	DPCA	CINCHES OF MATERIA	, mr. 12.	1.0	10.0	10.0	10.0	10.0	10.0	10.0	0.01	10.0	ŧ.		,	0.2268	0.2784	2551-0	0.1266	0.0525	0.0259	0.0139	0.0089	0.0
S. CCNICAL	R OF PRIM	, ,	1777N W	SIACK L	STACK D	G SIACK L/C:	PCR	LINCHES		16.9	13.9	14.9	15.8	17.0	17.3	17.4	17.4	17.5	*		9	9		0.5154	0.5370		0.1412	0.7628		***
FOUR NOZZLES, CCNICAL TRANSITION, STANDUFF 0.25	NUPBER G	X1170		TXTA	¥IXIW	MIXING	z	RUN	_	• (7 (.	3	'n	•	7	3 0	σ	z	RUN		• •	, נ	n •	ru	n .	۰ ۱	_ ,		* ~

0.010 0.070 0.070 0.069

690 0

690.0

0.069 0.069 0.069

PIXING STALK PRESSURE DISTRIBUTIONS FOR RUN: 9 -0.775 PPS ALIN. H2C): -1.220

Table XIX. Four-Nozzle Performance Data for L/D = 3, $M_{\rm u}=0.068$, Conical Transition. (a) S/D = 0.25-0.003 -0.004 -0.015 -0.230 -0.017 -0-036 -0.455 -0.032 -0.056 PHS E(1N. H20): -1.110 -0.775 PHS* B: -0.080 -0.056 FMS* A: -0.088

-0.035

-0-310

-0-445

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CAIA TAKEN 14 AUG 77 BY PETE HARRELL

FOUR NOZZLES, CCNICAL IRANSITION, STANDUFF 0.0

4/2/3.0/0/10

																UPT MACH		0.070	0.070	0.070	690.0	0.069	0.069	0.069	0.069	690.0
	•			Ş	(EA	tES)										3	(F1/SEC)	84.13	84.62	84.49	84.39	84.25	84-22	84.18	84.18	83.83
3.00 INCHES	3.00	2.154 INCHES		29.72 INCHES HG	SECONDARY AREA	(SQUARE INCHES	0.0	0.785	1.767	3.142	6.284	9.621	13.548	17.081	*****	N 5	(FI/SEC)	84.73	88.23	112.07	123.17	134-41	138.52	139.35	140.60	****
			A: 0.70		PA-PN2	ER)	5.03	3.57	2.19	1.80	0.13	16.0	61.0	0.13	0.0	ď	(F1/SEC)	254.22	253.88	253.49	253.17	252.77	252.66	252.55	252.54	251.49
UPTAKE DIAMETER:	AREA RATIU, AM/AP:	ORIFICF DIAMETER:	ORIFICE BEIA: 0.70	AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	5.03	3.97	2.19	1.80	0.73	0.37	61.0	0.13	0-0	N.	(LBM/SEC) (LBM/SEC) (FI/SEC)	0.0	650.0	0.100	0.142	0.181	961.0	0.200	0.204	•
Š	AR	90	g	4	PU-PA	CINC	05-9	1.60	9.70	9.10	10.60	11.00	11.10	11.10	11.30	ď	(LBM/SEC)	0-264	0.264	0.265	0.265	0.265	0.265	0.265	0.265	0.266
					TAMB	HE LT)	75.0	15.0	15.0	15.0	15.0	15.0	15.0	75.0	15.0	55"**1*M		0.0	0.1884	0.3550	0.5064	0.6443	0.6972	0.7083	0.7243	*****
	v	1			1901	(DEGREES FARKENHEIT)	154.0	154.0	154.0	154.0	154.0	154.0	154.0	154.0	0.641	P*/I*		0.4057	0.3210	0.2263	0-1464	0.0596	0.0298	0.0155	0.0102	0.0
4	FIER: 0.866 INCHES	9.00 INCHES	FR: 3.00 INCHES	}	108	1056	154.0	154.0	154.0	154.0	154.0	154.0	154.0	154.0	145.0	*	•	0.8713	0-6713	0.8713	0.8713	0.6713	0.8713	6113	0.8713	0.6784
× 4522165:	O TRAITERS O	CIP: 0.00	METER: 3.		÷ OPGR	F NATER!	16.6	10.0	10.0	10.0	10.0	10.0	10-0	10.0	10.0	,Q		0.3535	7672.0	0-1572	0.1275	0.0519	0-0260	0.035	6803-0	0.0
A VOANTOO SO ASSUUM	NOFBER OF FALARY M	2 27770 L	MIXING STACKANIAMETER	HIXING STACK L/G:	9()6	(INCHES OF WATER)	12.5	9-61	14.8	15.8	16.7	17.1	17.1	17.2	17.4	3	•	5	0.2002	0.3772	0.5381	0-6846	0-1408	0-7526	2271.5	*****
6	NOFEER	NAME 27.	SHIVIE	HIXING	2	2 2	-	. ^	. ~	1 4	· vc	۰ ،	, ,	• œ	· •	•	2 3	NO.	۰ ،	, ,		· vr	۱ ،	· •	- 0	

MIXING STACK PRESSURE DISTRIBUTIONS FOR RUN: 9

900*0-- 0.060 -0.060 -0.00% -0.330 -0.024 -0.022 -0.305 -0.550 -0.047 -0.650 -0.042 9.0 -(.530 -0.065 -0.505 -0.067 PMS A(IN. H20): -1.390 PMS* E: -0.093 PHS* A: -C.100 PRS B(IN. H20): -1.290 0.0 :0/X

Table XIX. Continued. (b) S/D = 0.0

CATA TAKEN 14 AUG 77 BY PETE FARRELL

O

4/2/3.0/-025/10	
STANDUFF -9.25	
. TRANSITION,	
CONICAL	
FOUR NOZZLES,	

																UPT MACH	3	0.070	0.010			690.0	0.069	690.0	4
		:		5S HG	/ AREA	INCHES	•	0.785	1.767	3.142	84	521	949	181	*	3	(FT/SEC)	84.76	84.66	84.47	84.37	84.24	84.11	84.10	
3.00 INCHES	3.00	ORIFICE DIAMETER: 2.154 INCHES		29.72 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.0	3.7	3.1	6.284	9.621	13.548	17.081	*****	¥5	(FI/SEC)	84.76	99.48	111.80	123.42	133.36	19.961	138-54	
		METER: 2	A: 0.70		PA-PNZ	(ER)	5.15	4.08	2.14	1.17	0.10	0.35	0.19	0.12	0.0	ď	(FT/SEC)	52.452	254.01	253.43	253.12	252.12	252.35	252.31	1
UPTAKE DIAMETER:	AREA RATIO, AM/AP:	RIFICE DI	URIFICE BETA: 0.70	AMBIENT PRESSURE:	PA-PS	(INCHES OF WATER)	5.15	4.08	2.74	1.17	0.70	0.35	61.0	0.12	0.0	SM	(LBM/SEC)	0-0	0.054	0.099	0.141	0.170	161.0	0.197	
ā	Ĭ,	ō	ō	₹	PU-PA	CINC	06.30	7.60	8.60	09.6	10.50	10.70	10.80	10.90	11.00	d M	(LBM/SEC)	0.264	0.264	0.264	0.265	0.2 éS	0.765	0.265	,
					TAMB	ENHEST)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	55*** I*A		0.0	0.1909	0,3518	0.5022	0.6310	0.6780	0669*0	0000
	IES				1 401	(DEGREES FAHRENHEIT)	154.0	154.0	154.0	154-0	154.0	153.0	153.0	150.0	150.0	*1/*d		0.4151	0.3296	0.2224	0.1440	0.0571	0.0282	0.0151	0000
4	ER: 0.966 INCHES	9.00 INCHES	3.00 INCHES		10A	1901	154.0	154.0	154.0	154.0	154.0	153.0	153.0	150.0	150.0	2		0.8713	0.6713	0.6713	0.8713	0.8713	0.6727	0.8727	07.70
RY NOZZLES				C: 3.00	CPCR	CF NATER!	, 16.0	10.C	10.0	10.0	10.C	10.0	10.C	10.0	10.0	å		0.3617	0.2872	1631.0	0.1255	0.0498	0.C246	0.0132	7000
NUMBER OF PRIMARY NOZZLES:	PRIMARY ACZZLE CIAMETI	MIXING STACK LENGTH;	MIXING STACK DIAMETER:	MIXING STACK L/C: 3.00	PCR	(INCHES OF NATE	12.5	13.8	14-7	15.7	16.6	16.8	17.0	17.0	17.1	*		o•c	0.2029	0.3738	C.5336	0.6705	0.1199	0.7421	0 7617
NUME	PRIA	KIXI	HIXI	KIXI	z	RUN	-	~	e	4	S	9	~	30	o	z	RUN		7	'n,	4	vs.	9	~	3

MIXING STACK PRESSURE DISTRIBUTIONS FUR RUN: 9

-0.110 -0.075 -0.005 -0.385 -0.030 -0.425 -0.028 -0.053 -0.710 -0.145 -0-051 -0.076 -C.C71 -1.060 -6.995 PMS* B: -0.059 PMS* A: -0.106 PHS 8(IN. P20): -1.380 PHS ALIN. +2011 -1.480

(c) S/D = -0.25 Table XIX. Continued.

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DATA TAKEN 13 AUG 77 B) PETE HARRELL

																	UPT MACH		0.010	0.070	0.070	690.0	690.0	690.0	590.0	0.069	0.069
-				116	AREA	Curci	CHE 3 I		ıņ ا	4	2	•	==	80	=	*	3	(FT/SEC)	84.70	84.56	84.43	84.31	84.26	84.22	64.19	84.19	94.10
,	3.00 INCHES 3.00	2.154 INCHES		29.73 INCHES HG	SECONDARY AREA	A COULABE INCHES	I STOAME IN	0.0	0.185	1.767	3.142	6.284	9.621	13.548	17.081	* * * * * * * * * * * * * * * * * * * *	¥	(FT/SEC)	84.70	06.36	112.14	123.58	133.72	136.62	137.85	138.30	*****
	~		A: 0.70	SSURE: 29	PA-PN?		EK)	5.32	40.4	2.82	1.79	11.0	0.34	0.18	0.12	0.0	å	J		253.10	253.29	252.94	252.80	252.66	252.59	252.58	252.30
	UPTAKE DIAHETER: : Area ratio, am/ap:	ORIFICE DIANETER:	ORIFICE BETA: 0.70	AMBIENT PRESSURE:	>d- ¥ d		(INCHES OF WATER)	5-32	4-04	2.82	1.19	0.71	0.34	0.18	0.12	0.0	S	3		0.053	0.100	0.142	0.179	C. 190	0.154	0.196	*****
	5 ₹	Ō	Ō	₹	A 0 = 110		2	05-9	7.60	8.80	9.80	10.90	11.30	11.40	11.40	11.50	à	CI BM/SEC)	0.264	0.264	0.265	0.265	0.265	0.265	0.265	0.265	0.266
						054	MIEIT)	75.0	15.0	75.0	15.0	15.0	15.0	15.0	15.0	15.0	77 ** 240		0.0	0.1900	0.3568	0.5049	0.6352	0.6728	0-6892	6.6945	*****
	S)			,		(DEGREES FAHRENHEIT)	153.0	153.0	153.0	153.0	154.0	154.0	154.0	154.0	153.0	117		7867 0	0.3265	0.2287	5571 0	0230	0.078	0-0147	10.00	0.0
SIAMBULT 012	4 4 1NCHE	A. C.	Inches	3.00 INCHES	,	10K	1066	153.0	153.0	153.0	153.0	154.0	154.0	154.0	154.0	153.0	į	<u>.</u>		0.9727	0 8727	0 9727	0.6723	6113-0	417.0	0.6113	0. £727
	Y NCZZLES:	יייייייייייייייייייייייייייייייייייייי	,	2		DPCR	F WATERS	10.0	10.0	0.01	16-6	0,01	10-0	10.0	10.0	10.0	;	•	,	0.3140	0/33*1	0.11.0	0.1210	\$04.7°0	2.53.0	0.1120	7807-0
FOUR NOZZEES, NO IKANSLITUR,	NUMBER OF PRIMARY ACZZLES: 4	INT NECLE L	MIXING STACK LENGTHS	MIXING STACK DIAFETERS		PCR	(INCHES OF WATE	12.4	13.7	6-61	6.91	17-0	27.3	17.4	17.5	17.5		*	,	0.0	1102.0	6976-0	10550	0.6749	0.7148	0.1323	0.1319
JR NOZZLES	NUMBE	TK S W	XIXIX	MIXIM		z	RUA	-	. ~	ו ת	۱ ۱	rv	n 4	. ~	- «	• •		z	RON	 (7	71	4	ĸ	9	~	ec c

PIXING STACK PRESSURE DISTRIBUTIONS FOR RUN:

Four-Nozzle Performance Data for L/D = 3, $M_u = 0.068$, Straight Entrance. (a) S/D = 0.50Table XX. -0.100 -0.017 -C-240 -0.210 -0.015 ~0.560 -0.040 -0.675 -0.048 -1.340 -1.246 -0.688 PMS 8(IN. H20): -2.160 PHS* A: -0.170 PMS+ B: -0.154 PMS ALIN. F201: -2.390

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ESTA TAKEN 13 AUG 77 BY PETE HARRELL

												HPT MACH		0.070	0.010	0.010	0.069	0.069	0.069	0.069	0.069	690.0
	S S	AREA	VCHES)		S :	ā :	4 4	: =	• •	2 =	. *	15	(FT/SEC)	84.71	84.57	84.39	84.29	84.16	84.10	84.09	84.08	94.CO
	3.00 INCHES 1 3.00 2.154 INCHES 10 29.73 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	10101	482.9	9-621	13.56	- 40 - 61	******	×	(FT/SEC)	84.71	72.66	111.87	123.23	132.56	135.34	136.27	137.00	****
	··· 9	PA-PNZ	WATER)	5.32	4.02	1.7	0.68	0.33	0.17	11.0	0.0	ď	5	254.15	253.12	253,20	252.90	252.49	252.33	252.29	252.25	252.01
	UPTAKE DIAMETER: AREA RATIO, AM/AP: URIFICE DIAMETER: URIFICE BETA: 0.7	PA-PS		5.32	20-4	1.76	99*0	0.33	0.17	0.11	0.0	SH	(LBM/SEC)	0.0	0.053	660*0	0.141	0.175	0.185	0.189	0-192	*****
		PU-PA	=	6.40	9-60	9.70	10.60	10.80	11.00	11.00	11.10	ž	(LBM/SEC)	992-0	0.264	0.265	0.265	C-265	0.265	0.265	0.265	0.266
4/0/3/025/10		ТАНВ	ENMEIIJ	75.0	75.0	75.0	75.0	75.0	75.0	75.0	15.0	55"**I*M		0.0	0.1895	0.3537	0-5007	0.6218	0.6580	0029-0	0.6795	****
0.25	CHES	TUPT	TOCONCES FARKENHEIIJ	153.0	153.0	153.0	153.0	153.0	153.0	153.0	152.0	*1/*4		0.4285	0.3249	0-2248	0.1432	0.0555	0.0266	0.0139	0.0000	0.0
	LES: 4 :R: 0.866 INC 9.00 INCHE 3.00 INCHE	1 8	3	153.0	153.0	153.0	153.0	153.0	153.0	153.0	152.0	±		0.8727	0.3121	0.5121	0. E/2/	0.8727	77840	0.8727	0.672	0. e /4 l
NŠÍTJOA, SI	TANY NUZZLES: E DICMETER: 0 -ENGTF; 9.00 OIAMETER: 3.00	DPCR CF MATERIA		10.0	10.0	10.0	1C.0	10.0	10.0	10.0	10.0	**		0.2759	668250	1961-0	6-21-0		2620.0	0.030	0.00	ر •
S, NU TRA	NUMBER OF PRIMANY NUZZLES: 4 PRIMARY NUZZLE CICMETER: 0.866 INCHES RIXING STACK LENGTP; 9.00 INCHES RIXING STACK DIAMETER: 3.00 INCHES PIXING STACK LC: 3.00	. PCR DPCI	12.5	13.8	14.7	15.8	16.7	16.9	17.1	17.1	17.2	•	,	2.0	2102-0	2,12,0	2157-0	700000	6.2113	2217	*****	÷ •
FOUR NGZZLES, NU TRANŠITION, STANDOFF	NUME PRIP RIXI MIXI	NO N	-	N	m	4	vn. ·	•	~	S	Φ	Z		• ،	1 ~	4	· v	۰ ۵		· cc	_	

-0.120 -0.110 -0.008 -0.009 PIXING STACK PRESSURE CISTRIBUTIONS FOR RUM: 9 -0.260 -0.019 -0-305 -0.022 -0-185 -0.056 -0.890 -0.064 1.5 -1.640 -1.690 -C-121 -0.117 PMS E(IN. H20): -2.850 PMS A(IN. F20): -3.100 PMS* 8: -0.204 PMS+ A: -0.222 X/0: 0.5

(b) S/D = 0.25 Table XX. Continued.

CATA TAKEN 13 AUG 77 BY FETE HARRELL

FOUR NCZZLES, NO TRANSITICA, STANDOFF

4/0/3/0/10

0.0

PRIMARY NOZZLE CIAM RIXING STACK LENGTI MIXING STACK L/D: N PCR CIAPE NUM (INCHES CF 1 12.5 1 2 13.6 1 3 14.3 1	LE CIAMETER: LENGTH: 9-0 LIAPETER: 3 L/G: 3-00 CPCR ES CF NATER) 10-0 10-0	HETER: 0.866 INCHES F: 9.00 INCHES TER: 3.00 INCHES 3.00 PCR TOR MATER) (DEGREI	ES		< (AREA RATIO, AM/AP: 3.00 Orifice Diameter: 2.154		3.00 2.154 INCHES		
IXING STACK IXING STACK IXING STACK IXING STACK IXING STACK IIIOCHI	168: 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0	O INCHES -OO INCHES TOR			(RIFICE DIA		.154 INCHES		
IIXING STACK IIXING STACK CINCHI (INCHI 12.5 13.6 14.3	3.0 3.0 PCR C.C C.O	.00 INCHES TOR TOEG			5					
MIXING STACK PCR (INCH 12.5 13.6		TOR (DEG			ā	URIFICE BETA: 0.70	A: 0.70			
-		TOR (DEG			₹	AMBIENT PRESSURE:		29.73 INCHES HG	HG	
	5	930)	1901	TAMB	PU-PA	PA-PS	PA-PNZ	SECONDARY AREA	AREA	
13.6			(DEGREES FAIRENHEIT)	ENHE I T)	CINC	(INCHES OF WATER)	ER)	(SQUARE INCHES!	CHES)	
13.6	~ ~ ~	153.0	153.0	15.0	07-9	5.15	5-15	0.0		
14.3	~ ~	153.0	153.0	15.0	7.50	3.91	3.51	0.785	ĸ	
	-	153.0	153.0	15.0	8.20	2.50	2.50	1.767	2	
14.8	•	153.0	153.0	15.0	8.70	1-44	1.44	3.142	2	
15.1	10.0	153.0	153.0	15.0	9.10	0.51	0.51	6.284	•	
15.2	10.0	153.0	153.0	15.0	9-10	62.0	0.23	9.621	-	
15.3	10.0	153.0	153.0	15.0	9-20	61.0	0.13	13.548	80	
15.3	10.0	153.0	153.0	15.0	9.20	0.08	90.0	17.081	~	
15.4	10.0	153.0	153.0	15.0	9.30	0.0	0.0	*****	•	
*	å	±	P*/1*	77"**I*M	d.	MS	ИР	¥	3	UP T MAC
RUA					(LBH/SEC)	(LBM/SEC) (FI/SEC)	(FI/SEC)	(FT/SEC)	(FI/SEC)	
0.0	0.2623	0.8727	0.4151	0.0	0.264	0.0	254.04	84.67	84-67	0.070
0.1565		0.6727	0.3163	0.1869	0.264	0.052	253.59	99.02	84.52	0.070
0.3570	0 0.1774	0.8723	0.2033	0.3362	0.265	960.0	252.91	110.40	84.30	0.069
0.4615	5 6.1026	0.6727	0.1176	0.4535	0.265	0.127	252.39	119.35	84-13	0.069
0.5700	0 0.0361	0.8727	0.0414	0.5369	0.265	0.151	251.90	125.68	83.56	0.069
0.5889	9 0.0165	0.6727	0.0189	0.5547	0.265	0.156	251.76	127.02	83.91	690*0
0.4113	3 C.CC90	0.8727	6010.0	0.5757	0.265	0.162	251.72	128-65	83.50	0.069
0.4165	5 0.0057	0.8127	9900*0	0.5807	0.265	0.163	251.69	129.02	83.89	0.00
*****	0.0	0.6727	0.0	******	0.265	*****	251.67	*****	83.89	0.069

-0.125 -0.115 -0.008 PIXING STACK PRESSURE CISTRIBUTIONS FOR RUN: 9 -0.026 -0.325 -0.023 -0.365 -0.705 -0.051 -0.049 -0.685 1.5 -C-110 -1.350 -C-100 -1.530 PMS B(IN. H20): -2.620 PMS ALIN. H201: -2.630 PPS* A: -0.188 PMS+ 8: -0.188 X/0: 0.5

(c) S/D = 0.0 Table XX. Continued.

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AUG 77 BY PETE HARRELL	,
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CATA TAKEN 14	

	0.070 0.070 0.070 0.070 0.069 0.069 0.069	
5	NEA HES) 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
3.00 INCHES : 3.00 2.154 INCHES 70 29.74 INCHES HG	SECONDARY AREA (SQUARE INCHES) 0.0 0.785 1.767 3.142 6.284 9.621 13.548 17.081 444444444444444444444444444444444444	
ETER: 3.00 AH/AP: 3. METER: 2.: A: C.70 SSURE: 29	-PN2 -40 -96 -96 -10 -10 -11 -11 -11 -11 -11 -11 -11 -11	
UPTAKE DIAMETER: 3. AREA RATIO, AM/AP: OKIFICE DIAMETER: ORIFICE BETA: C.70	PA-PS PA	
	HP (LBM/SE 0.266 0	
4/0/2/020/10	TANB 15.0 15.0 15.0 15.0 15.0 15.0 15.0 15.0	
O.5 ACHES S HES	TUPT TAMB (DEGREES FAHRENHEIT) 0 153.0 75.0 0 153.0 75.0 0 153.0 75.0 0 153.0 75.0 0 153.0 75.0 0 153.0 75.0 0 153.0 75.0 0 153.0 75.0 0 153.0 75.0 153.0 75.0 153.0 75.0 153.0 75.0 153.0 75.0 153.0 75.0 153.0 75.0 153.0 75.0 153.0 75.0 153.0 75.0 153.0 75.0 153.0 75.0 153.0 75.0 153.0 75.0 153.0 75.0 153.0 0.0 153.	
STANDOFF 0.9 LES: 4 R: 0.866 INCH 6.00 INCHES 3.00 INCHES	108 153 153 153 153 153 153 153 153 153 153	
ISITION, ST TARY NCZZLE E CIAMETER: LENGTH; 6.	FIRCK L/C: 2.00 POR DPOR (INCHES CF hATER) 12.5 10.0 13.8 10.0 15.9 10.0 17.4 10.0 17.5 10.0	
FOUR NOZZLES, NO TRANSTITION, STANDOFF 0.5 RUMBER OF PRIMARY NCZZLES: 4 PRIMARY NCZZLE CIAMETER: 0.866 INCHES MIXING STACK LENGTH: 6.00 INCHES MIXING STACK DIAMETER: 3.00 INCHES	POR DOOR (INCHES CF hater) 12.5 10.0 13.8 10.0 13.9 10.0 13.9 10.0 13.9 10.0 13.5 10.0	
FOUR NOZZLES, NU TRA NUMBER OF PRI PRIMARY NCZZL HIXING STACK HIXING STACK	TO T	•

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MIXING STACK PRESSURE DISTRIBUTIONS FCK RUN: 9

Four-Nozzle Performance Data for L/D = 2,

(a) S/D = 0.50

 $M_u = 0.068$, Straight Entrance.

Table XXI.

100.0--0.125

-0.620

-0.044

PMS B(IN. H20): -2.11 -1.240 PMS+ B: -0.165 -C.C88

-0.100

-0.590 -0.042

-1-200 -0.086

PHS ((IN. H2U): -2.420

K/D: 0-3

PMS# A: .0.173

1.3

CATA TAKEN 14 AUG 77 BY PETE FARRELL

FOUR NOZZLES, NO TRANSITIEN, STANDOFF

4/0/2/055/10

												UPT MACH		0.070	0.070	0.070	690.0	690.0	690*0	690.0	690.0	690.0
914	AREA	снеѕв		so.	2	7	•	**	80	-	•	n	(F1/SEC)	84.69	84.54	84.38	84.25	84.13	84.09	84.06	84.06	83.58
3.00 INCHES 3.00 2.154 INCHES) 29.74 INCHES HG	SECCNDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	17.081	*****	5	(FI/SEC)	84.69	99.02	111.09	121.72	130.53	133.71	134.68	134.51	****
ETER: 3.1 AM/AP: METER: 2 A: 0.70 SSURE: 2	DA-PN2	ERJ	5.28	3.50	29.2	1.63	0.63	0.31	0.16	01.0	0.0	9	(FT/SEC)	254.08	253.63	253.15	252.77	15.252	252.21	252.21	252.20	251.96
UPTAKE DIAMETER: 3.00 INCHES AREA RATIO, AM/AP: 3.00 UKIFICE DIAMETER: 2.154 INCH ORIFICE BETA: 0.70 AMBIENT PRESSURE: 29.74 INCH	PA-PS	(INCHES CF WATER)	5.28	3.90	29.2	1.63	0.63	16.0	91.0	0.10	0.0	X X	(LBM/SEC)	0.0	0.052	160.0	0.136	C. 168	C-180	0.183	0.183	******
3 4 5 6 4	PU-PA	LINCH	05-9	7.10	8.80	9.10	10.60	10.80	10.90	11.00	11.10	d.	(LBM/SEC)	0.264	0.265	0.265	0.265	0.265	0.265	0.265	0.266	992.0
	1 AMB	NHE I T	15.0	15.0	15.0	75.0	75.0	15.0	75.0	15.0	15.0	55°**1*M		0.0	0.1866	0.3439	0.4819	0.5961	0.6374	0.6500	0.6478	******
Si	TUPI	(DEGREES FAHRENHEIT)	153.0	153.0	153.0	153.0	153.0	153.0	153.0	153.0	152.0	*1/*d		9.4253	0.3153	0.2126	0.1327	0.0510	0-0249	0.0131	0.0082	0.0
2LES: 4 ER: 0.366 INCIIES 6.00 INCIIES : 3.00 INCIIES	3	(ueG	153.0	153.0	153.0	153.0	153.0	153.0	153.0	153.0	152.0	<u>*</u>		0.6727	0.8727	0.6727	0.8727	0.8727	0. e727	0.8727	0.8727	0.8741
TY NCZZLES: 1AMETER: 0.5 GTH: 6.00 METER: 5.00	UPER	F NATER!	10.0	10.0	16.6	10.0	10.01	10.0	10.0	0.01	10.0	å		2115.0	0.2751	0.1655	0.1158	0.0445	0.0217	0.0114	0.0071	0.0
NUPEER OF PRIMARY NCZZLE PRIMARY NCZZLE CIAMETER: PIXING SIACK LENGIN: 6.º MIXING SIACK DIAMETER: MIXING SIACK L/C: 2.00	PCR	LINCHES CF NATI	12.5	13.9	15.0	15.8	16.7	16.9	17.0	1.71	17.2	1		0.0	C.1982	0.3651	0.5116	6269-0	0.6768	0.6902	0.6879	*****
NUPEER PRIMAR PIXING MIXING	z	RUN	-	8	in	4	v	9	2	80	•	z	RUN	-	2	m	4	S	9		33	6

MIXING STACK PRESSURE CISTRIBUTIONS FOR RUN: 9

-0.150	-0.011	-0.155	-0.011
-0.190	-0.056	-0.825	-0.059
-1.500	-0.107	-1.500	-0.107
-2.810	-0.201	-2.810	-0.201
PMS A(IN. H20):	EMS* A:	PMS B(IN. F20):	PMS+ B: -0.201 -0.107 -0.059 -0.011
	FMS A(IN. H20): -2.810 -1.500 -0.790 -0.150	FMS A(IN. h20): -2.810 -1.500 -0.790 -0.150 fMS* A: -0.201 -0.107 -0.056 -0.011	FMS A(IN. h20): -2.810 -1.500 -0.790 -0.150 FMS* A: -0.201 -0.107 -0.056 -0.011 FMS B(IN. H20): -2.810 -1.500 -0.825 -0.155

(b) S/D = 0.25
Table XXI. Continued.

CATA TAKEN 14 AUG 77 BY PETE HARRELL

FOUR NOZZLES, NG TRANSITION, STANDOFF

4/0/2/0/10

												UPT MACH		0.010	0.000	690.0	.690*0	690.0	690.0	690.0	690.0	690.0
# 6	AREA	CHES)		s,	2	2	7		89			25	(F1/SEC)	84.63	14.48	84.24	84.08	83.53	83.88	93.86	83.85	83.64
3.00 INCHES 3.00 2.154 INCHES 00 29.74 INCHES HG	SECONDARY AREA	(SQUARE INCHES)	0.0	0.785	1.767	3.142	6.284	9.621	13.548	17.081	****	¥ 5	(FT/SEC)	84.63	98 -46	108.78	116.36	121.74	123.05	123.88	122.93	****
62 29	PA-PN2	ER)	2.00	3.64	2-21	1.21	0.42	61.0	01.0	90.0	0.0	d.	(F1/SEC)	253.90	253.43	252.74	252.27	251.80	251.66	251.60	251.58	250.92
UPTAKE DIAMETER: 3 AREA RATIO, AM/AP: ORIFICE DIAMETER: ORIFICE BETA: 0.70 AMBIENI PRESSURE:	PA-PS	(INCHES OF WATER)	2.00	3.64	2.21	12-1	0.42	0.19	0.10	90.0	0.0	H.S	(LBM/SEC) (FI/SEC)	0.0	150.0	0.389	0-117	0.137	0-142	0.145	0.141	****
5 4 5 5 4	PU-PA	CINC	07-9	7.70	8.40	8.80	09*6	9.00	9.00	00*6	9.00	å	(LBM/SEC)	0.264	0.264	0.265	0.265	0.265	0.265	0.265	0.265	0.266
	TAMB	NIIE I T)	15.0	75.0	75.0	15.0	75.0	15.0	15.0	15.0	15.0	N+T++.44		0.0	€081.0	0.3160	0.4156	1985.0	0.5042	0.5151	0.5030	******
· 83	rupr	(DEGREES FAHRENHEIT)	153.0	153.0	153.0	153.0	153.0	153.0	153.0	153.0	150.0	P*/I*		0.4033	0.2947	0.1799	6950.0	0.0340	0.0156	0.0082	0.0049	0.0
	T 08	930)	153.0	153.0	153.0	153.0	153.0	153.0	153.0	153.0	150.0	*		0.8727	0.6727	0.8727	0.6727	0.6727	0.8727	0.8727	0.8727	0.6770
VY NCZZLES: CIAMETER: 0. VGTH: 0.00 APETER: 3.C	DPCR	CF SATER!	10.0	10.C	10.0	10.0	10.0	10.0	10.0	10.0	10°C	đ		0.3520	C.2572	0.1570	0,0863	0.0257	0.0136	0.6672	0.0043	0.0
NUMBER OF PRIMARY NCZZLI PRIMARY NOZZLE CIAMETER: MIXING STACK LENGTH; 6. PIXING STACK DIAPETER: MIXING STACK L/C: 7.00	PUR	LINCHES CF NA	12.5	13.8	14.5	15.0	15.1	15.1	15.1	151	15.1	ä	i	0.0	0.1515	C-3355	0.4412	0.5167	0.5353	0.5469	0.5341	* * * * * *
NUMBE PRIMI MIXIN PIXIN	z	RUA	-	2	m	4	Ś	٠	1	3 0	6	z	RUN :	-	۸,	m	4	Ś		2	3 0	٠

MIXING STACK PRESSURE DISTRIBUTIONS FOR RUN:

-0.125 -0.014 -0.200 -0.056 -0.135 -0.053 -0.775 1.3 -1.310 -0°C34 PMS B(IN. H20): -2.710 -1.540 PMS* 8: -0.195 -C.111 PMS A(IN. 120): -2.530 PHS* A: -0.182 x/0: 0.3

Table XXI. Continued.

(c) S/D = 0.0

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CATA TAKEN 9 AUG 77 BY FETE HARRELL

FGUR NOZZLES, ELLIPTIC TRANSITION, STANDUFF 0.0, L/O = 7.57

AMBIENT PRESSURE' = 29.77 [N.HGA, TEMPERATURE = 73.0 DEG.FAHR PRIMARY (UPTAKE) TEMPERATURE = 151.0 DEG.FAHR

DIAMETRIC POSITICA (INCHES)	RADIUS (INCHES)	(OSH • NI)	919 (10.4401)	(FT/SEC)	(FT/SEC)	VA/VAVG	VB/VAVG
0.075	1.425	3.40	3.40	129.0	129.0	0.89	0.89
0.225	1.275	4.20	4.10	143-4	141.7	0.99	0.98
0.375	1.125	4.50	4.30	148 - 4	145.1	1.03	1.01
0.525	C-975	4 • 60	4.50	150.1	. 148.4	1.04	1.03
0.615	C.825	4. 70	4.60	151.7	150.1	1.05	1.04
0.825	0.675	4.80	4.60	153.3	150.1	1.06	1.04
0.575	C. 5 25	4.90	4.80	154.9	153.3	1.07	1.06
1.125	0.375	4.90	5.00	154.9	156.5	1.07	1.08
1.275	0.225	5.00	5.00	156.5	156.5	1.08	1.08
1.425	G.C75	5'• 00	5.10	156.5	158.0	1.08	1.10
1.575	G.075	5.00	5.10	156.5	158.0	1.08	1.10
1.725	0.235	5.00	5.10	156.5	158.0	1.08	1.10
1-675	0.375	4.90	5.00	154.9	156.5	1.07	1.08
2.025	0.525	4.90	4.90	154.9	154.9	1.07	1.07
2.175	C.675	4. 80	4.80	153.3	153.3	1.06	1.06
2.325	0.825	4.70	4.60	151.7	150-1	1.05	1.04
2.475	C.975	4.60	4.50	150.1	148.4	1.04	1.03
2.625	1.125	4.40	4.20	146.8	143.4	1.02	0.99
2.775	1.275	4.10	3.80	141.7	136.4	0.98	0.95
2.925	1.425	3 . 20	2.90	125.2	119.2	0.87	0.83

INTEGRATED VOLUMETRIC FLOW RATE = 7.08 CU.FT/SEC

INTEGRATED MASS FLCW RATE = 0.484 LBM/SEC AVERAGE VELOCITY = 144.28 FT/SEC

MCMENTUM FACTOR, KF = 1.005

PRIMARY VELOCITY AT NOZZLE EXIT = 251.64

(a) L/D = 7.57

Table XXII. Mixing Stack Exit Velocity Profile Data for Four Nozzles, $M_{_{\rm II}}$ = 0.068, Elliptic Transition.

CATA TAKEN 11 AUG 77 BY PETE HARRELL

FOUR NOZZLES. ELLIPTIC TRANSITION, STANDOFF 0.0. L/D = 5.57

AMBIENT PRESSURE = 29.71 IN.HGA, TEMPERATURE = 73.0 DEG.FAHR PRIMARY (UPTAKE) TEMPERATURE = 152.0 DEG.FAHR

DIAMETRIC POSITION (INChES)	RADILS (INCHES)	PTÅ (10-H20)	PTB ([N.H2O]	(FT/SEC)	(FT/SEC)	VA/VAVG	V8/VAVG
0.075	1.425	3.80	3.00	136.6	121.4	0.94	0.84
0.225	1.275	4.30	3.40	ذ.145	129.2	1.00	0.89
0.375	1.125	4.50	3.60	148.6	133.0	1.03	0.92
0.525	C. 975	4.70	3.90	151.9	138.4	1.05	U.95
0.615	Q. 825	5.10	4.20	158.2	143.6	1.09	0.99
0.825	C.675	5.10	4.50	158 - 2	148.6	1.00	1.03
0.625	C.525	5.10	4.90	158.2	155.1	1.09	1.07
1.125	C-375	5.10	5.10	158 • 2	158.2	1.09	1.09
1.275	0.225	5.10	5.10	158.2	158.2	1.09	1.09
1.425	C.075	5.10	5.10	158.2	158.2	1 •09	1.09
1.575	0.075	5-10	5.10	158 - 2	158.2	1.09	1.09
1.725	C-225	5.10	5.10	158.2	158.2	1.09	1.09
1.875	0.375	5.10	5.10	158.2	158.2	1.09	1.09
2.025	0.525	5.10	4.90	158.2	155.1	1.09	1.07
2.025	C.675	5.10	4.60	158.2	150.3	1.09	1.04
2.325	C.825	5.20	4.40	159.8	147.0	1.10	1.01
	0.575	5.10	4.20	158.2	143.6	1.09	0.99
2.475		5.00	4.10	156.7	141.9	1.08	0.98
2.625	1.125 1.275	4.50	3.90	148.6	138.4	1.03	0.95
2.775 2.925	1.425	3.60	3.00	133.0	121.4	0.92	0.84

INTEGRATED VOLLMETRIC FLOW RATE = 7.12 CU.FT/SEC

INTEGRATED MASS FLCW RATE = 0.485 LOM/SEC AVERAGE VELOCITY = 144.95 FT/SEC MOMENTUM FACTOR, KM = 1.006 PRIMARY VELOCITY AT NOZZLE EXIT = 252.11

(b) L/D = 5.57
Table XXII. Continued.

CATA TAKEN 12 AUG 77 BY PETE HARRELL

FOUR NOZZLES, ELLIPTIC TRANSITION, STANDOFF 0.0, L/D = 4.57

AMBIENT PRESSURE = 29.71 IN.HGA, TEMPERATURE = 72.0 DEG.FAHR
PRIMARY (UPTAKE) TEMPERATURE = 150.0 DEG.FAHR

DIAMETRIC POSITION (INCHES)	RACILS (INCHES)	ATQ (CSH•N1)	819 (OSH-N1)	(FT/SEC)	(FT/SEC)	VA/VAVG	V8/VAVG
0.075	1.425	3. 20	2.30	125.2	106.1	0.87	0.74
0.225	1.275	3.70	3.00	134.6	121.2	0.94	0.84
0.375	1.125	4 - 20	3.30	143.4	127-1	1.00	0.88
0.525	C-575	4.70	3.60	151.7	132.8	1.05	0.92
0.675	C-825	5.10	4.00	158.0	140.0	1.10	0.97
0.825	C.675	5 - 40	4.50	162.6	148.4	1.13	1.03
0.575	0-525	5.50	4.90	164.1	154.9	1.14	1.08
1-125	0.375	5.50	5.10	164.1	158.0	1.14	1.10
1.275	C.225	5.30	5.20	161.1	159.6	1.12	1.11
1.425	C.C75	5.20	5.20	159.6	159.6	1.11	1.11
1.575	0.015	5.20	5.10	159.6	158.0	1.11	1.10
1.725	C.225	5.10	5.00	158.0	156.5	1.10	1.09
1.875	0.375	5-10	5.00	158.0	156.5	1.10	1.09
2.025	0.525	5. 20	4.90	159.6	154.9	1.11	1.08
2.175	C.675	5.30	4.70	161.1	151.7	1.12	1.05
2.325	0.825	5.30	4.40	161.1	146.8	1.12	1.02
2.475	C-575	5.20	4.20	159.6	143.4	1.11	1.00
2.625	1.125	5.20	4.00	159.6	140.0	1.11	0.97
2.775	1-215	4.80	3.90	153.3	138.2	1.07	0.96
2.925	1.425	4 • 20	3.50	143.4	130.9	1.00	0.91

INTEGRATED VOLUMETRIC FLOW RATE = 7.06 CU.FT/SEC

INTEGRATED MASS FLGW RATE = 0:400 LBM/SEC AVERAGE VELOCITY = 143.85 FT/SEC PCKENTUM FACTOR, KM = 1.010 PRIMARY VELOCITY AT NOZZLE EXIT = 251.70

(c) L/U = 4.57

Table XXII. Continued.

DATA TAKEN 19 AUG 77 BY PETE FARRELL

FOUR NOZZLES, ELLIPTIC TRANSITION, STANDOFF 0.0, L/D = 3

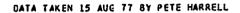
AMBIENT PRESSURE = 29.83 IN.HGA, TEMPERATURE = 74.0 DEG.FAHR PRIMARY (UPTAKE) TEMPERATURE = 152.0 DEG.FAHR

DIAMETRIC POSITION (INCHES)	RADILS (INCHES)	(IN-H2O)	(IN.H20)	(FT/SEC)	(FT/SEC)	VA/VAVG	VB/VAVG
0.075	1.425	3.20	1.30	125.1	79.8	0.89	0.57
0.225	1.275	3.90	1.60	138.2	88.5	0.98	0.63
0.375	1.125	5.10	1.90	158.0	96.4	1.13	0.69
0.525	C. 975	6.60	2.60	179.7	112.8	1.28	0.80
0.675	0.825	7-10	3.70	186 - 4	134.6	1.33	0.96
0.825	0.675	7.00	4.40	185.1	146.7	1.32	1.05
0.575	G. 5 2 5	6 • 40	5.00	177.0	156.4	1.26	1-12
1-125	C.375	5.70	5.30	167.0	161.1	1.19	1.15
1.275	0.225	5.CO	4.90	156.4	154.9	1.12	1.10
1.425	G.C75	4 • 60	4.60	150.0	150.0	1.07	1.07
1.575	0.075	4.60	4.60	150.0	150.0	1.07	1.07
1.725	0.225	4.80	4.60	153.3	150.0	1.09	1.07
1.675	G.375	5 • 20	4.90	159.5	154.9	1-14	1.10
2.025	0.525	5.90	5.00	169.9	156.4	1.21	1.12
2.175	C-675	6.50	4.70	178.4	151.7	1.27	1.08
2.325	0.825	7.00	4.10	185.1	141.7	1.32	1.01
2.475	C.975	7.10	3.50	186.4	130.9	1.33	0.93
2.625	1.125	6 - 40	2.80	177.0	117-1	1.26	0.83
2.775	1.275	4.90	2 - 20	154.9	103.8	1.10	0.74
2.925	1.425	3.90	1.90	138.2	96.4	0.98	0.69

INTEGRATED VOLUMETRIC FLOW RATE = 6.89 CU.FT/SEC

INTEGRATED MASS FLCW RATE = 0.471 L8M/SEC AVERAGE VELOCITY = 140.28 FT/SEC POMENTLM FACTOR, KM = 1.038 PRIMARY VELOCITY AT NOZZLE EXIT = 251.58

(d) L/D = 3.0
Table XXII. Continued.



FOUR NOZZLES. CONICAL TRANSITION, STANDOFF 0.0, L/D = 4.0

AMBIENT PRESSURE = 29.63 IN.HGA, TEMPERATURE = 74.0 DEG.FAHR
PRIMARY (UPTAKE) TEMPERATURE = 153.0 DEG.FAHR

DIANETRIC PGSITIGN (INCHES)	RADIUS (INCHES)	(OSH-N1)	(IN-HZO)	(FT/SEC)	(FT/SEC)	VA/V AVG	VB/VAVG
0.075	1.425	3.00	1.60	121.6	88.8	0.86	0.63
0.225	1.275	3.60	2.40	133.2	108.8	0.94	0.77
0-375	1.125	4.60	2-60	150.6	113.2	1.06	0.80
0.525	C. 975	5.40	3.00	163.2	121.6	1.15	0.86
0-675	0- 825	5.70	3.50	167.7	131.4	. 1.18	0.93
0.825	0.675	5 • 80	4-00	169.1	140.5	1-19	0.99
0.975	0.525	5.60	4.50	166.2	149.0	1.17	1.05
1.125	0.375	5.30	4-80	161.7	153-9	1-14	1.08
1.275	0.225	5-10	4.90	158.6	155.5	1.12	1.09
1.425	C.075	4.90	4-80	155.5	153.9	1.09	1.08
1.575	0.075	4.80	4.70	153.9	152.3	1.08	1.07
1.725	C. 225	4.80	4.70	153.9	152.3	1.08	1.07
1.875	0.375	5.00	4.80	157.0	153.9	1-11	1.08
2.025	0.525	5.20	4.80	160-1	153.9	1.13	1.08
2.175	0.675	5.50	4.70	164-7	152.3	1.16	1.07
2.323	0.825	5.70	4-40	167.7	147.3	1-18	1.04
2.475	G. 975	5. 70	4.20	167.7	. 143.9	1.16	1.01
2.625	1-125	5 - 50	4.00	164.7	140.5	1.16	0.99
2.775	1.275	5.10	3.70	158.6	135.1	1.12	0.95
2. 925	1.425	4-10	3.00	142.2	121.6	1.00	0.86

INTEGRATED VOLUMETRIC FLOW RATE = 6.97 CU.FT/SEC

INTEGRATED MASS FLOW RATE = 0.473 LBM/SEC AVERAGE VELOCITY = 142.03 FT/SEC PCMENTUP FACTOR, KM = 1.018 PRIMARY VELOCITY AT NOZZLE EXIT = 252.60

(a) L/D = 4.0

Table XXIII. Mixing Stack Exit Velocity Profile Data for Four Nozzles, : $M_{\rm u}$ = 0.068, Conical Transition.

DATA TAKEN 14 AUG 77 BY PETE HARRELL

FOUR NOZZLES, CONICAL TRANSITION, STANDOFF 0.0, L/D = 3.0

AMBIENT PRESSURE = 29.72 [N.HGA. TEMPERATURE = 74.0 DEG.FAHR PRIMARY (UPTAKE) TEMPERATURE = 153.0 DEG.FAHR

DIAMETRIC POSITION (INCHES)	RADIUS (INCHES)	(1N.H2O)	(IN-H20)	(FT/SEC)	(FT/SEC)	VA/VAVG	V8/VAVG
0.075	1-425	1.90	1.70	96.7	91.4	0.68	0.65
0.225	1-275	4.00	2.30	140-2	106.3	0.99	0.75
0.375	1.125	5.10	2.50	158.4	110.9	1-12	0.78
0.525	C.575	4.50	3-10	178.8	123.5	1.26	0.87
0.675	0.825	:7 - 20	3.90	188.2	138.5	1.33	0.98
0.825	0.675	7.20	4.70	188-2	152.0	1.33	1.07
0.575	0.525	4.60	5.20	180.1	159.9	1.27	1.13
1.125	0.375	5.80	5.20	168.9	159.9	1.19	1.13
1-275	0.225	5.00	4.80	156.8	153.6	1-11	1.09
1.425	G-075	4.50	4.50	148.7	148.7	1.05	1.05
1.575	0.075	4 • 40	4.30	147.1	145.4	1.04	1.03
1.725	C+ 225	A. 50	4.40	148.7	147-1	1.05	1.04
1.875	0.375	4.90	4.60	155.2	150-4	1-10	1.06
2.025	0.525	5.60	4.80	165.9	153.6	1.17	1.09
2.175	C.675	6.40	4.50	177.4	148.7	1.25	1.05
2.325	0.825	7.00	3.80	185.5	136.7	1.31	0.97
2.475	0.575	÷7• 30	3.10	189.5	123.5	1.34	0.87
2.625	1.125	6.40	2.60	177.4	113.1	1.25	0.80
2.775	1.275	5 • 40	2.30	162.9	106.3	1.15	0.75
2.925	1-425	4-00	1.90	140.2	96.7	0.99	0.68

INTEGRATED VOLUMETRIC FLOW RATE = 6.94 CU.FT/SEC

INTEGRATED MASS FLOW RATE = 0.473 LBM/SEC AVERAGE VELOCITY = 141.42 FT/SEC MOMENTUM FACTOR, KM = 1.036 PRIMARY VELOCITY AT NOZZLE EXIT = 252.24

(b) L/D = 3.0
Table XXIII. Continued.

CATA TAKEN 13 AUG 77 BY PETE HARRELL

FOUR NOZZLES, NO TRANSITION, STANDOFF 0.0, L/D = 3

AMBIENT PRESSURE = 29-73 IN-HGA, TEMPERATURE = 71.0 DEG.FAHR
PRIMARY (UPTAKE) TEMPERATURE = 152.0 DEG.FAHR

DIAMETRIC POSITION (INCHES)	RADILS (INCHES)	(OSH-N3)	819 (OSH•N])	(FT/SEC)	(FT/SEC)	VA/VAVG	V8/VAVG
0.075	1.425	4.20	2.30	143.4	106.1	1.14	0.85
0.225	1.275	5.10	2.70	158.1	115.0	1.26	0.92
0.375	1-125	5.10	2.70	158 • 1	115.0	1 • 26	0.92
0.525	C.975	4.50	2.70	148.5	115.0	1.18	0.92
0.675	0.825	3.70	2.60	134.6	112.9	1.07	0.90
0.825	0.675	2.80	2.40	117.1	108.4	0.93	0.86
C.575	C.525	2.20	2.20	103.8	103.8	0.83	0.03
1.125	C-375	1.70	1.80	91.3	93.9	0.73	0.75
1.275	0.225	1.30	1.70	79.8	91.3	0.64	0.73
1.425	C.C75	1.00	1.40	70.0	82.8	0.56	0.66
1.575	0.075	1.10	1.40	73.4	82.8	0.58	0.66
1.725	C • 225	1.50	1.60	85.7	88.5	0.68	0.71
1.875	G-375	1.50	1.60	85.7	88.5	0.68	0.71
2.025	0.525	1.90	2.10	96.5	101.4	0.77	0.81
2.175	C.675	2.90	2.70	119.2	115.0	0.95	0.92
2.325	0.825	3.50	2.90	130.9	119.2	1.04	0.95
2.475	C.975	4 - 30	3.20	145.1	125.2	1.16	1.00
2.625	1.125	4.70	3.40	151.7	129.1	1.21	1.03
2.775	1.275	4.70	3.60	151.7	132.8	1.21	1.06
2.925	1.425	4 • 20	3. 30	143.4	127.1	1.14	1.01

INTEGRATED VOLUMETRIC FLOW RATE # 6.16 CU.FT/SEC

INTEGRATED MASS FLCW RATE = 0.421 L8M/SEC

AVERAGE VELOCITY = 125.51 FT/SEC

MOMENTUM FACTOR, KM = 1.022

PRIMARY VELOCITY AT NOZZLE EXIT = 251.27

(a) L/D = 3.0

Table XXIV. Mixing Stack Exit Velocity Profile Data for Four Nozzles, $M_U = 0.068$, Straight Entrance.

DATA TAKEN 14 AUG 77 BY PETE HARRELL

FOUR NOZZLES, NO TRANSITION, STANDOFF 0.0, L/D = 2

AMBIENT PRESSURE = 29.74 IN.HGA, TEMPERATURE = 74.0 DEG.FÄHR PRIMARY (UPTAKE) TEMPERATURE = 146.0 DEG.FAHR

DIAMETRIC POSITION (INCHES)	RADIUS (INCHES)	(IN.HZO)	(IN-HZO)	(FT/SEC)	(FT/SEC)	VA/VAVG	VB/VAVG
0.075	1.425	4- 20	1.70	143.2	91.1	1.22	0.77
0.225	1.275	5.50	1.60	163.9	88.4	l.39	0.75
0.375	1.125	7.10	1.60	186.2	88.4	1.58	0.75
0.525	C. 975	17.30	1.50	188.8	85.6	1.60	0.73
0.675	0.825	5.50	1.50	163.9	85.6	l.39	0.73
0.825	G-675	3.70	1.30	134.4	79.7	1.14	0.68
0.975	.0.525	2.10	1.10	101.2	73.3	0.86	0.62
1.125	C.375	1.00	0.80	69.9	62.5	0.59	0.53
1.275	0.225	0.50	0.50	49.4	49.4	0.42	0.42
1.425	0.075	Q.30	0.30	38.3	38.3	0.32	0.32
1.575	C-075	0.30	0.30	38.3	38.3	0.32	0.32
1.725	G.225	0.50	0.50	49.4	49.4	0.42	0.42
1.875	0.375	1.00	0.80	69.9	62.5	0.59	0.53
2.025	G. 525	1.90	1.10	96.3	73.3	0.82	0.62
2.175	0.675	3.50	1.70	130.7	91.1	1.11	0.77
2.325	C- 825	5-40	1.90	162.4	96.3	1.38	0.82
2-475	C. 975	7.00	1.90	184.9	96.3	1.57	0.82
2.625	1.125	.7.00	1.90	184.7	96.3	1.57	0.82
2.775	1.275	5.50	1.90	163.7	96.3	1.39	0.82
2.925	1-425	4.10	1.70	141.5	91.1	1.20	0.77

INTEGRATED VOLUMETRIC FLOW RATE = 5.78 CU.FT/SEC

INTEGRATED MASS FLOW RATE = 0.397 LBM/SEC AVERAGE VELOCITY = 117.82 FT/SEC MOMENTUM FACTOR, KM = 1.083 PRIMARY VELOCITY AT NOZZLE EXIT = 250.11

(b) L/D = 2.0
Table XXIV. Continued.

APPENDIX A

CALCULATION OF THE MOMENTUM CORRECTION FACTOR

The momentum correction factor is defined as the ratio of the actual momentum rate to the rate based on the bulk-average velocity. Defining the actual momentum as that obtained by integrating over the velocity surface, the momentum correction factor may be written as

$$K_{\rm m} = \frac{1}{W_{\rm m} U_{\rm m}} \int_{0}^{A_{\rm m}} U_{2}^{2} \rho_{2} dA$$
 (4)

The density of the air at the mixing stack exit ρ_2 is a weighted average of the densities of the primary and secondary air flows. Assuming a secondary to primary mass flow rate ratio of 0.65, which is consistent with experimental results, ρ_2 is expressed as

$$\rho_2 = \rho_{avg.} = \frac{\rho_s}{1.65} \left[0.65 + \frac{T_s}{T_p} \right].$$
 (a)

Using this average density of the mixed flow, the mass flow rate leaving the mixing stack may be expressed as

$$W_{m} = \rho_{avg} \cdot U_{m} A_{m} . \qquad (b)$$

Combining equations (4) and (b) results in an equation for the momentum correction factor in terms of the experimentally

determined mixing stack exit velocity profiles,

$$K_{\rm m} = \frac{1}{U_{\rm m}^2 A_{\rm m}} \int_0^{A_{\rm m}} U_2^2 dA$$
. (c)

Figure 40 illustrates the orientation of the two velocity traverses.

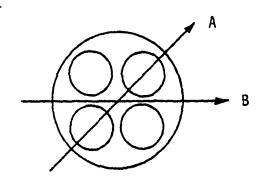


FIGURE 40. Orientation of Mixing Stack Exit Velocity Traverses

To integrate the mixing stack exit velocity over the threedimensional velocity surface using only the two traverses requires some approximations:

- Traverses A and B represent the maximum and minimum values of the velocity surface respectively.
- 2. The three-dimensional velocity surface is symmetrical, i.e. a velocity traverse passing above the other two primary nozzles, perpendicular to traverse A, is equal to that of traverse A and likewise for traverse B.

3. The circumferential variation of the velocity surface is sinusoidal with the maximum and minimum values at a given radius occurring at traverses A and B respectively.

The velocity traverse obtained experimentally consists of discrete points rather than a continuous curve. Each of these point values of velocity is representative of a radial element of the velocity traverse of length equal to the spacing between successive points. The procedure is to fit a circumferential sinusoidal curve through the maximum and minimum velocities of traverses A and B respectively. This circumferential band is then treated as a segment of the velocity surface of incremental width dr equal to the spacing between the data points and is integrated circumferentially over successive radial elements. Completion of the integration yields the actual momentum of the mixed cases leaving the exit of the mixing stack.

APPENDIX B

UNCERTAINTY ANALYSIS

The experimentally determined pressure coefficient and pumping coefficient are used in determining eductor operating points which in turn provide the basis for comparison and evaluation of eductor system performance. A determination of the uncertainties in these coefficients was made using the method described by Kline and McClintock [7]. Data for the eductor configuration described in Table VIIb is considered a representative case and is used to calculate representative uncertainties in the pumping and pressure coefficients.

For a single sample measurement the value of a specific variable should be given in the format:

 $x = \overline{x} \pm \delta x$

where

 \bar{x} = mean value of the variable x

 $\delta x = \text{estimated uncertainty in } x.$

Variations for the variables in the defining equations for the two coefficients are listed at the end of this appendix. Having described the uncertainties in the basic variables of a relationship, it is now necessary to determine how these uncertainties propagate into the result. Consider the relation where the result R is the product of a sequence of terms.

$$R = x_1^a x_2^b x_3^c$$
 (a)

A reasonable prediction of the uncertainty in the result R is obtained by using the Second Order Equation suggested by Kline and McClintock [6].

$$\delta R = \left[\left(\frac{\partial R}{\partial \mathbf{x}_1} \, \delta \mathbf{x}_1 \right)^2 + \left(\frac{\partial R}{\partial \mathbf{x}_2} \, \delta \mathbf{x}_2 \right)^2 + \left(\frac{\partial R}{\partial \mathbf{x}_2} \, \delta \mathbf{x}_3 \right)^2 \right]^{1/2}$$
(b)

Evaluating the partial derivatives appearing in equation (b) and normalizing by dividing through by R yields the simplified form of equation (b) which will be used in this analysis.

$$\frac{\delta R}{R} = \left[\left(\frac{a \delta x_1}{x_1} \right)^2 + \left(\frac{b \delta x_2}{x_2} \right)^2 + \left(\frac{c \delta x_3}{x_3} \right)^2 \right]$$
(c)

Determination of the uncertainty in the pressure coefficient is facilitated by writing it as the product of a series of terms,

$$\frac{\Delta P^*}{T^*} = (\rho_s)^{-1} (\Delta P) (U_p)^{-2} (T^*)^{-1} (d)$$

where ΔP represents the pressure difference $(P_a - P_0)$. Constants such as 2 g_c in the equation for the pressure coefficient will be cancelled out when used in equation (c) and are therefore not included in this analysis. Applying equation (c) to the pumping coefficient in equation (d) yields the following expression for its uncertainty:

$$\frac{\delta \frac{\Delta P^*}{T^*}}{\frac{\Delta P^*}{T^*}} = \left[\left(\frac{(-1) \delta \rho_s}{\rho_s} \right)^2 + \left(\frac{(-1) \delta (\Delta P)}{\Delta P} \right)^2 + \left(\frac{(-1) \delta T^*}{T^*} \right)^2 \right]^{1/2}$$

$$+ \left(\frac{(-2) \delta U_p}{U_p} \right)^2 + \left(\frac{(-1) \delta T^*}{T^*} \right)^2 \right]^{1/2}$$
(e)

Taking into account the respective equations defining the individual variables, the terms of equation (e) are expanded as follows:

$$\rho_{s} = \frac{P_{a}}{R T_{s}}, \qquad \left[\frac{\delta \rho_{s}}{\rho_{s}}\right]^{2} = \left[\frac{\delta P_{a}}{P_{a}}\right]^{2} + \left[\frac{\delta T_{s}}{T_{s}}\right]^{2}$$

$$U_{p}^{2} = \frac{2 g_{c} P_{v}}{\rho_{p}} = \frac{2 g_{c} R P_{v} T_{p}}{P_{u}},$$

$$\begin{bmatrix} \frac{(-2)}{U_p} & \delta U_p \\ \hline U_p & \end{bmatrix}^2 = \begin{bmatrix} \frac{(-2)}{P_v} & \delta P_v \\ \hline \end{bmatrix}^2 + \begin{bmatrix} \frac{(-2)}{T_p} & \delta T_p \\ \hline \end{bmatrix}^2 + \begin{bmatrix} \frac{(-2)}{T_p} & \delta P_u \\ \hline \end{bmatrix}^2$$

$$T^* = \frac{T_s}{T_p}, \quad \begin{bmatrix} \frac{\delta T^*}{T^*} \end{bmatrix}^2 = \begin{bmatrix} \frac{\delta T_s}{T_s} \end{bmatrix}^2 + \begin{bmatrix} \frac{\delta T_p}{T_p} \end{bmatrix}^2$$

Using the values of the variables and their respective uncertainties listed in Table XXV, the uncertainty in the pressure coefficient is estimated to be

$$\frac{\delta \left(\frac{\Delta P^*}{T^*}\right)}{\frac{\Delta P^*}{T^*}} = 0.005 = \pm 0.5\%$$

By a similar process, the uncertainty in the pumping coefficient is estimated to be

$$\frac{\delta (W*T*^{44})}{W*T*^{44}} = 0.028 = \pm 2.88$$

VARIABLE	VALUE	UNCERTAINTY
т _s	530 °R	± 1 °R
T _P	597 °R	± 1 °R
Pa	14.72 psia	± 0.01 psia
ΔΡ	0.12 in. H ₂ 0	± 0.005 in, H ₂ 0
P _v	0.98 in. H ₂ 0	± 0.01 in. H ₂ 0
Pu	9.6 in. H ₂ 0	± 0.1 in. H ₂ 0
$\Delta P_s(\dagger)$, $(\dagger\dagger)$	0.12 in. H ₂ 0	± 0.005 in. H ₂ 0
P _{or} (†)	15.6 in. H ₂ 0	± 0.1 in. H ₂ 0
ΔP _{or} (†)	10.0 in. H ₂ 0	± 0.1 in. H ₂ 0
T _{or} (†)	597 °R	± 1 °R

- (†) These quantities were used in calculation of the uncertainty in the pumping coefficient.
- (††) The pressure differential across the secondary flow nozzles ΔP is zero at the operating point. It is the major source of uncertainty in the pumping coefficient, however, and is therefore included here with a representative value.

Table XXV. Variables With Corresponding Uncertainties
Taken from Table VII(b)

BIBLIOGRAPHY

- 1. Pucci, P.F., Simple Ejector Design Parameters, Ph.D. Thesis, Stanford University, September, 1954.
- 2. Ellin, C.R., Model Tests of Multiple Nozzle Exhaust Gas Turbine Powered Ships, Engineers Thesis, Naval Postgraduate School, June 1977.
- 3. Moss, C.M., Effects of Several Geometric Parameters on the Performance of a Multiple Nozzle Eductor System,
 MS Thesis, Naval Postgraduate School, September, 1977.
- 4. American Society of Mechanical Engineers Interim Supplement 19.5 on Instruments and Apparatus, Fluid Meters, Sixth Edition, 1971.
- 5. Keenan, J.H. and Kaye, J., Gas Tables, John Wiley and Sons, Inc., 1963.
- 6. Kline, S.J. and McClintock, F.A., "Describing Uncertainties in Single-Sample Experiments," Mechanical Engineering, p. 3-8, January 1953.

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